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ABSTRACT

Efforts to reform and restructure science and mathematics education need to be based on a sound assessment of current conditions, the rate of improvement, and problems in the system. This report focuses on indicators of the condition of science and mathematics education at state and national levels. The 1995 report presents new state indicators from the 1993-94 school year and examines trends, by state, from 1990 to 1994 on indicators of student achievement, content and instruction, and context and conditions for teaching. Four primary sources of data were used: The National Assessment of Educational progress (NAEP), Advanced Placement examinations, The Schools and Staffing Survey, and data from state departments of education. Among the student achieement indicators, the study found that proficiency on the NAEP in mathematics had a significant improvement: the percentage of grade 8 students scoring at or above the proficient level went from 19 percent in 1990 to 25 percent in 1992; between 1982 and 1992 scores of Black and Hispanic students improved more than that of Whites, although the gap is still substantial. Among the findings in the area of content and instruction, the study found that enrollments, especially minority and female students, in science and mathematics have risen dramatically. In the area of teacher preparation and supply, the study found that three-fifths of secondary teachers with a main assignment in mathematics had a college major in math or mathematics education. In the area of conditions and context for teaching, it was found that the average public school spent only $50 on science software and $100 on mathematics software in 1993-94. Appendixes provide detailed data and information by state. (MKR/AA)

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State Indicators of Science and Mathematics Education

1995

State-by-State Trends and New Indicators from the 1993–94 School Year

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State Education Assessment Center

State Indicators of Science and Mathematics Education 1995

State-by-State Trends and New Indicators from the 1993–94 School Year

Rolf K. Blank
Doreen Gruebel

The development of State Science and Mathematics Indicators has been supported by a grant from the National Science Foundation. The indicators were developed and reported through the cooperation of 52 state education agencies and the National Center for Education Statistics of the U.S. Department of Education.

Council of Chief State School Officers

The Council of Chief State School Officers (CCSSO) is a nationwide, nonprofit organization of the 57 public officials who head departments of public education in every state, the District of Columbia, the Department of Defense Dependent Schools, and five extra-state jurisdictions. CCSSO seeks its members' consensus on major education issues and expresses their view to civic and professional organizations, to federal agencies, to Congress, and to the public. Through its structure of standing committees and special task forces, the Council responds to a broad range of concerns about education and provides leadership on major education issues.

The State Education Assessment Center is a permanent, central part of the Council of Chief State School Officers. This Center was established through a resolution by the membership of CCSSO in 1984.

The State Science and Mathematics Indicators were developed through cooperation of the Council with all of the state departments of education, the National Science Foundation, and the U.S. Department of Education. The Indicators were selected and designed to provide valid, comparable state-by-state and national data on the condition of science and mathematics education in elementary and secondary schools. Data are reported every two years using a consistent set of indicators.

The Council's work on Science and Mathematics Indicators is supported by a grant from the Division of Research, Evaluation, and Dissemination of the National Science Foundation, Education and Human Resources Directorate. The views or conclusions expressed in the report do not necessarily reflect the position of the National Science Foundation.

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This report is the result of successful cooperation of the Council of Chief State School Officers with the state departments of education, the National Science Foundation (NSF), and the U.S. Department of Education. The State Science and Mathematics Indicators were initiated in 1986 as a result of the commitment of the NSF to improving the quality of information on science and mathematics education in the nation's schools. The Council's work in developing a system of state-level indicators of science and mathematics education is made possible by the collective decision of the state superintendents and commissioners to have valid, comparable state-by-state data to assess educational progress.

The Science and Mathematics Indicators receive strong support from each of the state superintendents and commissioners. State data managers, science and mathematics specialists, and assessment directors have willingly given their time, expertise, and assistance to the project. State education staff have played active roles in the selection of indicators and design of a data reporting system, and some indicators are based on data from state education information systems.

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The Council staff and the states have benefited greatly from the insightful recommendations and suggestions of expert advisors since the beginning of our work. The state leaders, science and mathematics educators, researchers, and federal agency staff who advise us have ensured that the indicators are soundly based on research and that they provide important information for policy and program decisions.

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Summary of State Indicators of Science and Mathematics Education: 1995

The Council of Chief State School Officers goal in producing this report on science and mathematics indicators is to assist state, national, and local policymakers and educators in making informed decisions. Efforts to reform and restructure science and mathematics education need to be based on a sound assessment of current conditions, the rate of improvement, and problems in the system. This report focuses on science and mathematics indicators at state and national levels.

Improving student learning in mathematics and science is a priority for our elementary and secondary schools. The National Education Goals of the President and governors, set in 1989, state that science and mathematics achievement of American high school graduates will be first in the world by the year 2000. Educators at local, state, and national levels are working to implement national professional standards for mathematics education. The new national standards for science education will further advance science education reform.

The Council has led development of a system of state-by-state indicators of the condition of science and mathematics education. The indicators are intended for use by policymakers and educators to assess progress in improving mathematics and science education in our schools. This report is the third in a series of biennial Council reports on *State Indicators of Science and Mathematics Education*. The 1995 report presents new state indicators from the 1993–94 school year and examines trends, by state, from 1990 to 1994 on indicators of (a) student achievement, (b) content and instruction, and (c) context and conditions for teaching. The indicators were selected through consultation with state education leaders, science and mathematics educators, representatives of national professional organizations, and researchers. The Council's work in development of science and mathematics education indicators is supported by the National Science Foundation.

Summary of Indicators for 1995

Student Achievement in Mathematics and Science

Policy Issues. Is student achievement in mathematics and science improving, and how does achievement compare state to state? Are students learning challenging content?

- ***Student Proficiency on NAEP.*** Nationally, 25 percent of grade 8 students scored at or above the Proficient level on the 1992 National Assessment of Educational Progress (NAEP) in mathematics, which was a significant improvement from 19 percent in 1990. Eighteen percent of grade 4 students scored at or above the Proficient level.

- From 1990 to 1992, seven states made significant improvements in NAEP scores in grade 8 mathematics with increases of four to eight percentage points in the proportion of students at or above the Proficient level. States varied widely in student performance on NAEP Mathematics in 1992—six states had over 30 percent of grade 8 students score at or above the Proficient level, while in nine states less than 15 percent of students met the Proficient level.

- ***Trends on NAEP since 1982.*** Student proficiency scores on NAEP assessments in mathematics and science showed modest, but significant, improvement from 1982 to 1992. For example, the average score for 17-year-old students went up about 10 points on the NAEP scale in both math and science, or improvement roughly equivalent to one year of school.

- ***Advanced Placement participation.*** In 1994, 4.4 percent of grade 12 students took an AP exam in calculus, an increase from 4 percent in 1992. In science, 4.5 percent of students took an AP exam in 1994, up from 4.4 percent in 1992. Eight states had over 7 percent of students take the AP calculus exam, and four states had over 9 percent of students take an AP exam in science.

Policy Issue: Are schools improving the performance of all students?

- **Race/ethnicity and NAEP Math** Nationally, only 26 percent of black students scored at or above the Basic level on NAEP mathematics in 1992, while 73 percent of white students in grade 8 scored at or above the Basic level, or a disparity of 47 percentage points. The disparity in NAEP Mathematics scores between white and minority students decreased in 12 states between 1990 and 1992.
- Over the decade 1982 to 1992, NAEP mathematics and science scores of black and Hispanic students improved more than scores of whites, although the gap in achievement is still substantial (over 40 scale points). For example, mathematics scores of grade 4 black students improved over the decade by 13 scale points, or the equivalent of more than one year of school.
- **Gender and NAEP Results** The 1992 NAEP Mathematics Assessment showed no gender differences in scores of students at ages 9 or 13, and slightly higher scores for males at age 17, but the NAEP Science Assessment (national sample only) showed that females continue to score lower than males at ages 9, 13, and 17. The difference in NAEP Science scores between 17-year-old males and females (grade 12) is 10 scale points, or the equivalent of about one year of high school.

Mathematics and Science Content and Instruction

Policy Issue: What is the amount of class time students are taught math and science in elementary grades?

- Elementary class time spent on mathematics in grades 4-6 varied by state from over five hours per week, or 60 minutes per day, to four hours per week, or 45 minutes per day. Projected to a school year, the states with highest class time provide 36 hours, or seven weeks, more mathematics instruction than states with low average time.
- In science, average class time in grades 4-6 varied by state from four hours per week, or 45 minutes per day, to 2.3 hours per week, or 30 minutes per day. Projected to a school year, students in states with the highest science class time provided 45 hours, or 11 weeks, more science instruction than students in states with the lowest class time.
- Results of a new national survey of elementary teachers show that three instructional practices are used most often in elementary science classes: lecture or whole-class discussion (one-third of time); hands-on activities or laboratory work (one-fourth of time); and reading or doing work sheets (one-fourth of time).

Policy Issue: What proportion of students take challenging subject content in mathematics and science, as indicated by high school course enrollments?

- **Higher-level mathematics** As of 1994, 60 percent of high school students reach the third year of high school mathematics by graduation, as indicated by student enrollments in algebra 2 or integrated mathematics 3. State enrollments differ significantly—from over 75 percent of students in several states reaching this level of mathematics to under 45 percent in other states. From 1990 to 1994, eight states enrollment in algebra 2/integrated math 3 increased 10 or more percentage points, and nationally the percentage went up 11 points.
- **Higher-level science** Fifty-one percent of high school students now progress to a third year of high school science by graduation, as indicated by enrollments in chemistry as of 1994. In some states, over 67 percent of students took chemistry by graduation, while in others less than 40 percent reach this level in high school science. Six states increased their chemistry enrollments by 10 percentage points from 1990 to 1994, and nationally the percentage taking chemistry went up six points.
- **Decline in low-level mathematics** The proportion of high school students that are taking general, remedial, or consumer mathematics has declined by one-third since 1990. In 1994, one out of every seven (13 percent) high school

students was taking a general, remedial, or consumer math course, while in 1990 the figure was one out of five (19 percent). State enrollments vary from under 5 percent of students taking mathematics at this level to over 25 percent of students.

Policy Issue: *Have enrollments in higher-level mathematics and science courses increased since many states raised graduation requirements during the 1980's?*

- In the decade of the 1980's, over 40 states increased the number of course credits in mathematics and science required for graduation. From 1990 to 1994, all but two states reporting trend data showed increases of 1 to 12 percentage points in higher-level mathematics enrollments, and all but four states reported increases of 1 to 12 percent in higher level science enrollments.
- National sample data show that enrollments in science and mathematics have risen dramatically from 1982 to 1992—enrollments in algebra 2 increased from 37 percent to 56 percent of graduates, and enrollments in chemistry went up from 32 percent to 56 percent.

Policy Issues: *Are minority students increasing their participation in higher-level science and mathematics? Is the gender gap closing in higher-level science and mathematics?*

- ***Race/ethnicity and enrollments.*** Hispanic and American Indian students made the largest increases in algebra 2 enrollments—with both groups' enrollments doubling over 10 years to over 40 percent. Black and Hispanic enrollments in chemistry doubled over 10 years to over 40 percent of graduates while white enrollments increased over 20 percentage points to 50 percent, and Asian American enrollments increased to 67 percent.
- ***Gender and enrollments.*** State data trends show increased female enrollments in higher-level mathematics and science courses. In 1994, 17 states (of 19 reporting data by gender) had more females than males taking algebra 2 integrated math 3, and nine of 19 states had more females than males taking trigonometry or precalculus; 16 (of 19) states have more females taking chemistry than males.

Policy Issues: *To what extent are teaching practices consistent with national standards on teaching in mathematics and science? What instructional practices and curriculum content are associated with higher student achievement?*

- ***Content of curriculum.*** In the 1992 NAEP Mathematics, states in which grade 8 teachers placed higher emphasis on algebra functions and geometry had higher student mathematics proficiency. The states with higher percentages of teachers emphasizing numbers operations and measurement tended to have lower average NAEP mathematics proficiency at grade 8.
- ***Effective schools in mathematics.*** Analyses of the 1992 NAEP Mathematics results for grade 8 show several instructional practices are related to higher student proficiency: (a) more students doing math problems from textbooks almost every day; (b) moderate math testing (once or twice a month); (c) calculators used at least weekly; and (d) more students taking algebra. These results hold across schools with differences in socioeconomic and home background of students.

Teacher Preparation and Supply

Policy Issue: *What proportion of current teachers have knowledge and teaching skills in their field at the level outlined by professional standards?*

- ***Mathematics teachers with major in field.*** Nationally, three-fifths of secondary teachers with main assignment in mathematics have a college major in mathematics or math education. Among all teachers assigned to teach at least one secondary mathematics class, 61,000 teachers (41 percent) do not have a college major or minor in mathematics or math education.
- ***Science teachers with major in field.*** In the U.S., 69 percent of secondary science teachers with their main assignment in science have a major in a science discipline or science educa-

tion. Among teachers assigned at least one science class, 37,000 teachers (25 percent) do not have a college major or minor in science.

- ***NCTM standards and teacher preparation.*** The 1992 NAEP mathematics teacher questionnaire asked about teacher preparation in content areas advocated by the NCTM. Seven of the 10 states with the highest mathematics proficiency at grade 8 had over 55 percent of students with teachers that had coursework in the recommended content areas.
- ***Supply of minority teachers.*** Only five of the 20 states with more than 20 percent minority students have even half as many minority teachers in science and mathematics as the percentage minority students in these states.

Conditions and Context for Teaching

Policy Issues. Do science and mathematics teachers have too many students to teach each day? Do teachers have sufficient resources and materials to meet standards for science and mathematics instruction?

- ***Class size.*** The number of students per high school mathematics class varies from 16 students per class in Oklahoma and North Dakota to over 26 students per class in California and Florida which indicates that mathematics teachers work with over 50 percent larger classes in states with high population growth. The size of science classes varies from 16 students per class in Montana and Wyoming to 28 students in Utah.
- ***Science and math resources and materials.*** The average public school spent only $50 on science computer software and $100 on mathematics software in 1993-94. The average elementary school spent only 51 cents per student on science laboratory supplies, e.g., chemicals, batteries, glassware, and the typical middle school spent only 88 cents per student on science supplies. The average elementary school spent only $1 per student on math materials and manipulatives, and middle schools averaged only 40 cents per student on mathematics materials.

Introduction
Development of State Education Indicators for Policymakers

In cooperation with the state departments of education, federal agencies, and professional organizations, the Council of Chief State School Officers (CCSSO) has developed a system of state indicators of the quality of science and mathematics education in public schools. The present report is the third in a series of biennial reports on state indicators. The reports are primarily intended for use by policymakers and educators.

The design, management, and reporting of indicators has been supported by the National Science Foundation (NSF) since the project was initiated in 1986. The state departments of education make major contributions to the system through advice on selection of indicators, collecting and reporting data from schools, and disseminating the indicators within states. In selecting and reporting state indicators, we also consult with science and mathematics educators, education researchers, and statistical experts. The Council places high priority on advocating for improving the quality and comparability of assessments and data that can produce reliable indicators of the health of our elementary and secondary schools.

Why State Science and Mathematics Education Indicators?

The science and mathematics indicators developed by CCSSO and the states meet at least three kinds of interests expressed to us by policymakers and educators:

- Reliable, comparable indicators, by state, to assess progress toward the National Education Goals and state goals.
- A range of indicators and data to analyze the effects of state education policies and reform initiatives.
- Measures of the quality of science and mathematics education that are useful to educators and policymakers to plan programs, identify problems, and recommend new initiatives.

Efforts to develop a system of national and state indicators of the quality of science and mathematics education began in the mid-1980s. Widely read reports on the condition of elementary and secondary education, including *A Nation at Risk* (National Commission on Excellence in Education, 1983) and *Educating Americans for the 21st Century* (National Science Board, 1983) helped spur national and state reform initiatives; these reports also increased attention on improving the quality and availability of information to monitor progress and report on current conditions.

> *Reaching a new standard of excellence requires clear educational objectives, strong leadership and firm commitment at all levels. Goals must be set and press toward those goals assessed. The Federal government should finance and maintain a national mechanism for measuring student achievement and participation [in mathematics, science and technology education] in a manner that allows national, state and local evaluation and comparison of educational progress.*
>
> Educating Americans for the 21st Century
> (National Science Board, 1983)

A central reason for national and state cooperation toward a system of comparable state-level education indicators is that states establish much of the legal and policy structure for education. State leaders recognized that making major decisions about funding, programs, and standards requires high-quality information that is regularly and readily available.

In the 1980s, states initiated a broad set of education policy reforms, including increased course credit requirements for graduation (particularly in mathematics and science), higher standards for teacher preparation, teacher tests for certification, higher levels for teacher pay, state curriculum guidelines and frameworks, and new statewide student assessments [Blank & Dalkilic, 1992; Blank & Espenshade, 1988; National Governors' Association (NGA), 1986]. An initial motivation for the Council's system of science and mathematics indicators was to track these policy changes over time and report statistical indicators to assist states in analyzing the relationship of policies and reforms to improvements in education quality. The National Education Goals, established in 1989, provide another incentive for state education indicators; and CCSSO has worked with the National Education Goals Panel (NEGP) to share state data and develop indicators that will be broadly useful to national and state policymakers and educators.

Now, many states have placed a high priority on developing new state curriculum frameworks and standards for academic subjects that are the basis for state education improvements. In mathematics, the National Council of Teachers of Mathematics (NCTM) *Standards* (1989, 1991) are reflected in new state curriculum frameworks and in state efforts toward implementing mathematics education reforms (Blank & Pechman, 1995).In science, many states are developing new frameworks and standards using guidance from the American Association for Advancement of Science (AAAS) *Benchmarks for Science Literacy* (1993) and the NRC *Science Education Standards* (NRC, draft, 1994). State representatives advise CCSSO that they want to have indicators for science and mathematics education that will help them assess the progress of schools toward national and state standards.

The state indicators are also aimed at assisting state leaders and others in identifying state and national trends, planning and evaluating programs, and working on new initiatives. For example, the CCSSO indicators provide comparable state-level data to describe baseline conditions across 25 states involved with the NSF's Statewide Systemic Initiatives (SSI); the indicators also will be used to track overall progress at the state level and provide comparisons among SSI states and other states. As another example, all state education agencies administer the federally funded Eisenhower Science and Mathematics Program for teacher professional development; and the state indicators provide data on the demographic characteristics of the teaching force, rate of new teachers entering science and mathematics, and the current preparation of teachers in their assigned fields.

The science and mathematics indicators have other practical applications. State administrators have used course enrollment data to analyze differences in the level of course taking in their states, as compared to states in their region and states with similar demographic characteristics. Policymakers have been able to compare the proportion of science and mathematics teachers with a degree in their teaching field with recommended and proposed standards for teacher preparation. Teacher educators have identified teacher shortages by science specialization and by gender and race to target teacher recruitment and professional development programs.

How Are State Indicators Selected? Are They Comparable and Reliable?

The CCSSO system of state education indicators is based on three premises:

- Indicators should reflect the needs of users of education data, particularly policymakers and educators.
- Indicators should be selected with consideration and input from the providers of data, such as state data managers, districts, and schools.
- Indicators should be informed by a research-based model of the education system, including state context, school processes and resources, and student outcomes; and selected indicators should be measured with valid, reliable data.

Initially, we designed a conceptual framework for the state science and mathematics indicators through meetings with an expert panel and state education representatives and by review of the research literature on indicators and science and mathematics education (Murnane & Raizen, 1988; National Science Board, 1983, 1993; National Study Panel on Education Indicators, 1991; NGA, 1986; Oakes, 1986, 1989; Porter, 1991; Shavelson, McDonnell, & Oakes, 1987). Using this framework, we developed a list of desired, or ideal, science and mathematics indicators, organized in six categories: student outcomes, instructional time participation, curriculum content, teacher quality, school conditions, and equity. A survey of states and analysis of existing national surveys provided the basis for determining data availability on desired indicators and the potential for new data collection for the indicators (CCSSO, 1988a).

A key step was convening a task force of state science and mathematics specialists (data users) and data managers (providers), education researchers, and federal education staff to weigh the desired indicators against both the quality of available data and the feasibility of collecting and reporting data by state. After discussion and analysis, the group reached a consensus on a priority list of indicators that led to the first CCSSO report (Blank & Dalkilic, 1991). Subsequently, we have convened a task force every two years to review the prior CCSSO report, to assess the need for changes in the indicators, and to recommend improvements in reporting.

In the present report, we have continued to maintain two initial decisions about the method of analyzing and reporting state indicators. First, the CCSSO report does not add up or otherwise combine individual indicators, such as state rate of enrollment in advanced courses and average student achievement, to produce a composite score for a state. Reporting which states are "ahead" or "behind" other states is not a main purpose of the indicators (CCSSO, 1985). We encourage the use and interpretation of multiple indicators, which may be measuring different aspects of science and mathematics education. Second, this report provides no analysis of cause-and-effect relationships between indicators. The emphasis is on reporting variation and trends by state for individual indicators. Some sections refer to analyses that have been done, and we encourage further analysis of the data presented here. The indicators were selected by using a model of the educational system that helps educators identify factors that explain improvement in educational outcomes. Blank (1993) provides further information on the development of state education indicators.

What State Indicators Are Reported for 1995?

Indicators of Student Achievement in Mathematics and Science

- Student Proficiency on NAEP
- Mathematics and Science Proficiency by Student Race/Ethnicity and Gender
- Students Taking Advanced Placement Examinations

Indicators of Mathematics and Science Content and Instruction

- Elementary Class Time on Mathematics and Science
- Students Progressing to Three Years of High School Mathematics and Science
- State Requirements and Trends in Course Enrollments
- Course Enrollments by Race/Ethnicity and Gender
- Teaching Practices and Content Emphases in Instruction

Indicators of Teacher Preparation and Supply

- Teachers with Major in Assigned Field
- Teacher Coursework in Areas of Content Standards
- Teachers Certified in Assigned Field
- Teachers Race/Ethnicity, Gender, and Age

Indicators of Context and Conditions for Teaching

- Certified Teachers per 1,000 Students Taking Mathematics and Science
- Average Class Size in Mathematics and Science
- Instructional Resources and Materials

What Are the Sources of Data?

We used four primary sources of data to report the 1995 state science and mathematics indicators:

- The National Assessment of Educational Progress (NAEP) assessments in mathematics and science, administered by the NCES, are used to report indicators of student achievement by state.
- Results from the Advanced Placement examinations, administered by The College Board, also provide indicators of student achievement.
- The Schools and Staffing Survey is a source for state-representative data on teacher preparation and school conditions for science and mathematics. The Survey is conducted by NCES.
- The Council collected aggregated data from state departments of education on indicators of course enrollment, teacher assignments and

characteristics, and teacher certification. The data were collected through state information systems, and reported to CCSSO using standard data categories.

Further explanation of the data sources is provided in Appendix F.

Organization of the Report

The state indicators are outlined in the next four chapters of the report. Chapter 1 describes indicators of student achievement in mathematics and science. Chapter 2 includes indicators of subject content and instructional practices, with a focus on their relation to state policies and professional standards. Chapter 3 provides state indicators of the quality of preparation of teachers and trends in the supply of teachers. Chapter 4 has several indicators of conditions in schools for science and mathematics teaching. The Conclusions chapter provides an overview of the use of the state indicators to analyze education policies.

The Appendixes provide detailed data and information by state. Appendix A has state statistics on student background characteristics, number of students and teachers, and expenditures per pupil. Appendix B provides examples of NAEP mathematics assessment exercises and NAEP results by content area. Appendix C has detailed course enrollments by state. Appendix D provide details on teachers. Appendix E provides several indicators for city school districts in the Urban Systemic Initiatives program. Appendixes F and G provide information on the data and statistics used in the report.

Chapter One
Indicators of Student Achievement in Mathematics and Science

- **Student Proficiency on NAEP**
- **Mathematics and Science Proficiency by Student Race/Ethnicity and Gender**
- **Students Taking Advanced Placement Examinations**

Student Proficiency on NAEP

Policy Issues:

- *Is student achievement in mathematics and science improving, and how does achievement compare state to state?*
- *Are students learning challenging content in science and mathematics?*
- *Are schools improving the performance of all students?*

CCSSO strongly supports the development and use of state-level student assessments from NAEP as an indicator of student learning in mathematics and science. The Council led the "consensus planning process" that produced the Assessment Framework for the first NAEP assessment to report state-by-state scores (1990) and the consensus process for the 1996 NAEP Science Assessment. In the view of the Council, the NAEP assessment is the best source for student achievement indicators that are comparable state-to-state and adequately assess the range and depth of knowledge and student skills recommended by states and school districts.

The NAEP assessment results and supporting questionnaires from students and teachers are based on a sample of 2,000 students per state at each assessed grade. The data do not provide a way for states to analyze student achievement for each school and district. The results, however, are still extremely valuable as indicators. NAEP results provide a way to monitor state progress in student achievement; to assess education received by specific groups of students and, very important, to determine the relationship of student achievement to characteristics of schools, classroom practices, and teachers, by state.

Mathematics Proficiency at Grade 8 in 1990 and 1992

Table 1 provides summary statistics for state-by-state and national results from the 1992 NAEP mathematics assessment in grade 8. The table orders the states by the percentage of public school students at or above the Proficient level, which is defined, in brief, as follows:

> *Eighth grade students should apply mathematics concepts and procedures consistently to complex problems in the NAEP content areas—Numbers and Operations, Measurement, Geometry, Algebra and Functions, Statistics and Probability, and Estimation.*
>
> (Mullis, Dossey, Owen, & Phillips, 1993; levels are defined by the National Assessment Governing Board)

The percentage of students at or above the Proficient level is set as a key indicator by the National Education Goals Panel in its annual reporting on Goal 3 (1994).

- Seven states made significant improvement from 1990 to 1992 in the percentage of grade 8 students at or above the Proficient level. Eighteen states improved the average proficiency scale score at least four points.
- Nationally, 25 percent of grade 8 students scored at or above the Proficient level in 1992, and 4 percent were at or above the Advanced level, while 63 percent of grade 8 students scored at or above the basic achievement level. The percentage of grade 8 students above the Proficient level increased from 19 percent in 1990 to 25 percent in 1992, a significant improvement.
- State percentages of students at or above the Proficient level varied: six states were above 30 percent—Minnesota, Iowa, North Dakota, Wisconsin, Nebraska, Maine; while six states and three jurisdictions were below 15 percent—Mississippi, Louisiana, Alabama, Arkansas, West Virginia, New Mexico, District of Columbia, Guam, and Virgin Islands.

Figure 1 provides a bar graph portrayal by state of the percentage of public school students in grade 8 at or above the Proficient level in 1992, compared with that of 1990. States showing the greatest improvement in NAEP results over two years were Minnesota, Iowa, New Hampshire, Connecticut, Colorado, Texas, and North Carolina.

Table 1: Mathematics Proficiency of Grade 8 Students, 1992 NAEP

STATE	% at or Above Proficient Level 1992	Change 1990 to 1992: % at or Above Proficient Level	% at or Above Advanced Level	Average Proficiency 1992
Iowa	37 ◆	+7	5	283 ◆
Minnesota	37 ◆	+8	6 ◆	282 ◆
North Dakota	36	+2	4	283
Nebraska	32	+2	4	277
Wisconsin	32	+3	4	277
Maine	31	–	4	278
Connecticut	30 ◆	+4	4	273 ◆
New Hampshire	30 ◆	+5	3	278 ◆
Massachusetts	28	–	3	272
New Jersey	28	+3	4	271
Idaho	27	+4	3	274 ◆
Utah	27	–	3	274
Colorado	26 ◆	+4	2	272 ◆
Pennsylvania	26	+5	3	271
Wyoming	26	+2	2	274 ◆
NATION	25 ◆	+6	4	268 ◆
Indiana	24	+3	3	269
Maryland	24	+4	4	264
Missouri	24	–	3	270
New York	24	+5	4	266
Michigan	23	+3	3	267
Virginia	23	+2	3	267
Ohio	22	+3	2	267
Oklahoma	21	+4	2	267 ◆
Texas	21 ◆	+5	4	264 ◆
California	20	+4	3	260
Rhode Island	20	+2	2	265 ◆
Arizona	19	+3	2	265 ◆
Delaware	18	-1	3	262
Florida	18	+3	2	259
South Carolina	18	–	2	260
Kentucky	17	+3	2	261 ◆
Georgia	16	-1	1	259
Hawaii	16	+2	2	257 ◆
North Carolina	15 ◆	+4	1	258 ◆
Tennessee	15	–	1	258
New Mexico	14	+1	1	259 ◆
Arkansas	13	+1	1	255
West Virginia	13	+1	1	258
Alabama	12	0	1	251
Louisiana	10	+2	1	249
Mississippi	8	–	0	246
Guam	7	+2	1	234 ◆
Dist. of Columbia	6	+2	1	234 ◆
Virgin Islands	1	0	0	222 ◆

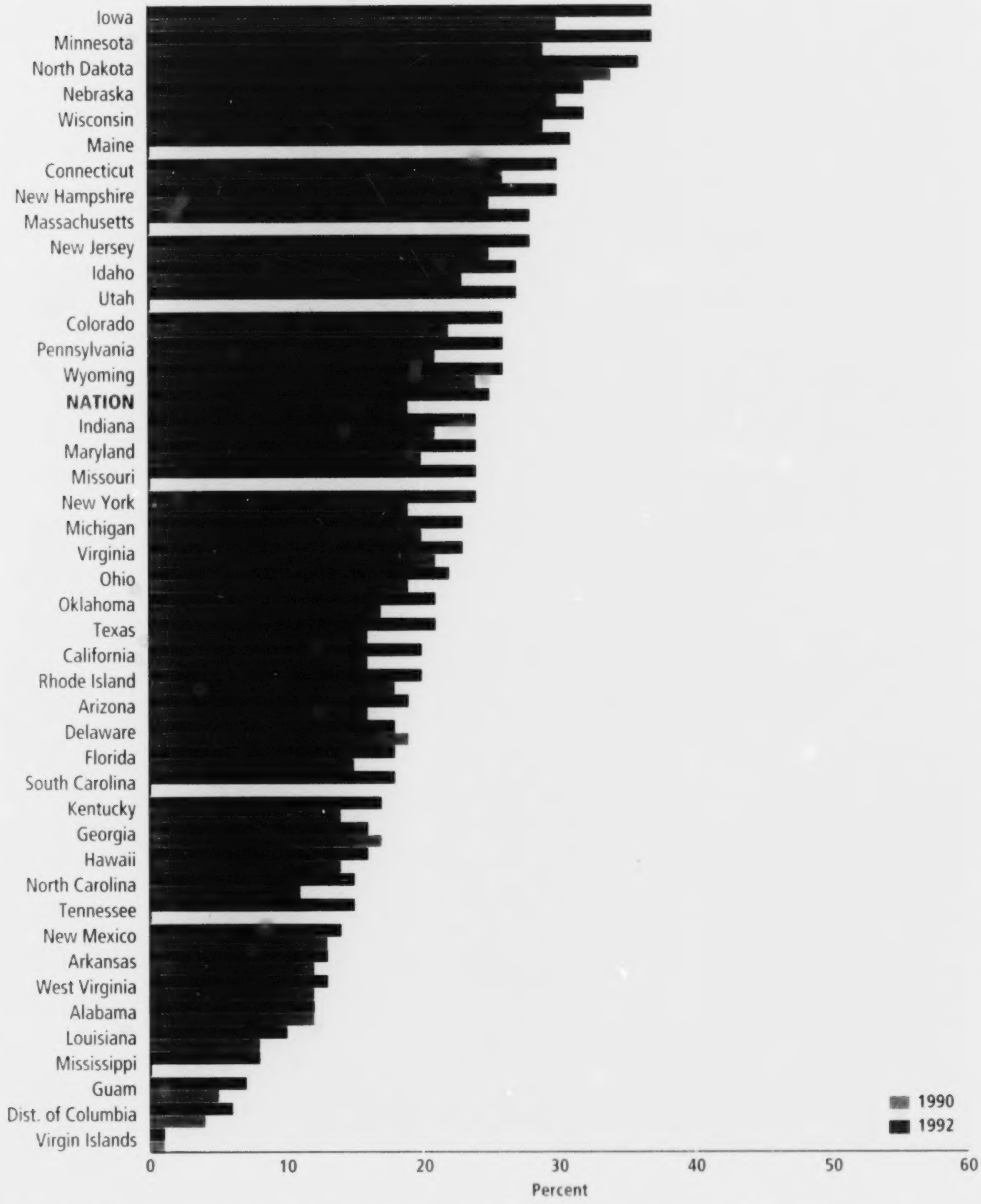
Note: ◆ Significantly higher than 1990 NAEP mathematics proficiency at about the 95% confidence level.

– Data not available.

States not participating in 1992 NAEP mathematics: Alaska, Illinois, Kansas, Montana, Nevada, Oregon, South Dakota, Vermont, Washington.

Source: Mullis et al. (1993). NAEP 1992 Mathematics Report Card for the Nation and the States, U.S. Department of Education (see for standard errors of estimates).

Figure 1: **Percentage of Students in Grade 8 at or Above Proficient Level, 1990 to 1992**



Example: The percentage of grade 8 students in Minnesota at or above the Proficient level increased 8 percentage points from 1990 to 1992.

Source: Mullis et al. (1993). NAEP 1992 Mathematics Report Card for the Nation and the States, U.S. Department of Education (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Mathematics Proficiency at Grade 4 in 1992

Table 2 lists the states by the percentage of public school students in grade 4 that scored at or above the Proficient level in mathematics in 1992. Also shown are the percentage above the advanced level and the average proficiency scale score for 1992.

- Nationally, 18 percent of grade 4 students were at or above the Proficient level.
- Seven states had one-fourth of students at or above the Proficient level—Maine, Minnesota, Iowa, New Hampshire, Wisconsin, New Jersey, Connecticut.
- In five states, 10 percent or less of grade 4 students scored at or above the proficient level—Alabama, Arkansas, Louisiana, Mississippi, Tennessee.

These aggregate figures on mathematics proficiency in Tables 1 and 2 can be disaggregated by content areas of mathematics that were assessed in the 1992 NAEP. The averages by content areas are shown in Appendix B for six mathematics content areas assessed in grades 4 and 8: Numbers Operations, Measurement, Statistics Probability, Algebra Functions, Geometry, and Estimation.

The NAEP results in these tables and graphs show a statistical distribution of where states are in relation to other states and the nation, but it is difficult to get an idea of what mathematics students at a given level can actually do. To provide a glimpse of the mathematics content and skills of students represented by the NAEP scores and levels, we provide sample exercises (or problems) in Appendix B. The 1992 sample exercises indicate the overall percentage of students scoring well on the problem and the percentage for students at or above a given level, for example, proficient.

The mathematics proficiency of students in each state can also be compared to the mathematics proficiency of students in other countries. Results from the 1992 NAEP and the 1991 International Assessment of Education Progress (IAEP), which is based on NAEP assessment items, show that proficiency scores for students in several states are as high as students in Taiwan, Korea, and Soviet Union. The variation in state proficiency scores is as great as variation among the 20 countries participating in the IAEP (see NCES, *Education in States and Nations*, 1993, p. 55).

Table 2: Mathematics Proficiency of Grade 4 Students, 1992 NAEP

STATE	% at or Above Proficient Level, 1992	% at or Above Advanced Level, 1992	Average Proficiency, 1992
Maine	28	3	231
Iowa	27	3	229
Minnesota	27	3	227
New Hampshire	26	3	229
Connecticut	25	4	226
New Jersey	25	3	226
Wisconsin	25	3	228
Massachusetts	24	3	226
Nebraska	23	3	224
North Dakota	23	2	228
Pennsylvania	23	3	223
Utah	20	2	223
Maryland	19	3	216
Michigan	19	2	219
Missouri	19	2	221
Virginia	19	3	220
Wyoming	19	2	224
Colorado	18	2	220
NATION	**18**	**2**	**217**
Delaware	17	2	217
New York	17	2	217
Ohio	17	2	217
Georgia	16	2	214
Idaho	16	1	220
Indiana	16	2	220
Texas	16	2	217
Hawaii	15	2	213
Florida	14	2	212
Oklahoma	14	1	219
Rhode Island	14	2	214
Arizona	13	1	214
California	13	2	207
Kentucky	13	1	214
North Carolina	13	2	211
South Carolina	13	1	211
West Virginia	13	1	214
New Mexico	11	1	212
Alabama	10	1	207
Arkansas	10	1	209
Tennessee	10	1	209
Louisiana	8	1	203
Mississippi	7	0	200
Dist. of Columbia	6	1	191
Guam	5	0	191

Source: Mullis et al. (1993). NAEP 1992 Mathematics Report Card for the Nation and the States (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Mathematics and Science Proficiency by Student Race/Ethnicity and Gender

A high priority for the Council's science and mathematics indicators is reporting on trends in equity in educational opportunity, conditions, and outcomes. One approach to indicators of equity in math and science education is disaggregating state averages according to differences in students' race/ethnicity and gender.

Minority-White Disparity by State

Table 3 provides state-by-state results from the NAEP 1992 grade 8 mathematics assessment reported by the percentage of public school students at or above the basic achievement level. The results are disaggregated by five race/ethnic groups. The Council's indicators place priority on tracking progress by the proportion of students meeting the proficient level. In this table, however, we use the percentage of students at or above the basic achievement level because the percentages for minority groups are too low in many states for useful comparisons. The nonwhite group with the highest student enrollment in each state is indicated on the table. See Appendix A for state enrollments by race/ethnicity.

Table 3 shows that all states, except Hawaii, have a significant disparity between the percentage of white students at or above the basic level and the percentage for the largest minority group.

- Nationally, the disparity is 47 percentage points—73 percent of white students are at or above Basic level, while only 26 percent of black students are at this level.
- Between 1990 and 1992, 12 states made progress in decreasing the minority-white disparity. Colorado, Minnesota, North Dakota, West Virginia, and Wisconsin closed the gap from three to 11 percentage points.

Figure 2 provides a bar graph showing the disparity in the percentage of white students scoring at or above basic mathematics level and the percentage for the largest minority group. For example, the disparity for Oklahoma is 17 percentage points—the difference between the 72 percent of white students at or above the basic level and the 55 percent for American Indian students. The disparity between white and black students in New York is 53 percentage points. Each state's disparity can be compared with the disparity for the nation of 47 points between whites (73 percent) at or above basic and the percentage for black students (26 percent). Over time, the disparity can be used as a comparative measure of states' effectiveness in increasing the performance of minority students relative to whites in mathematics.

Within-State vs. Between-State Variation

The differences in mathematics proficiency by race/ethnicity point out an important fact about that variation in NAEP proficiency scores. Differences in student math proficiency are much greater within each state than are the differences between the states. In Iowa, the difference in scores between students at the 10th percentile and students at the 90th percentile is 77 points (244 vs. 321). The difference between the average proficiency of Iowa students (high scoring state) and the average proficiency of Mississippi students (low scoring state) is only 43 points (Iowa—283 vs. Mississippi—246).

Table 3: Percentage of Grade 8 Students at or Above Basic Mathematics Level by Race/ Ethnicity, 1992 NAEP

	Percent at or Above Basic Level				
	White	Black	Hispanic	Asian/ Pacific Islander	American Indian
NATION	73	26 *	37	78	46
STATE					
Alabama	59	19 *	15	–	–
Arizona	74	42	40 *	–	47
Arkansas	61	18 *	23	–	–
California	73	26	34 *	69	–
Colorado	77	33	48 *	–	–
Connecticut	81	32 *	32 *	78	–
Delaware	69	31 *	33	–	–
Dist. of Columbia	–	24 *	22	–	–
Florida	70	27 *	40	–	–
Georgia	69	29 *	27	–	–
Hawaii	62	–	34	53 *	–
Idaho	76	–	46 *	–	51
Indiana	70	34 *	46	–	–
Iowa	83	–	53 *	–	–
Kentucky	61	30 *	26	–	–
Louisiana	59	22 *	21	–	–
Maine	79	–	–	–	60 *
Maryland	74	30 *	33	80	–
Massachusetts	74	35	30 *	–	–
Michigan	75	22 *	44	–	–
Minnesota	81	–	48 *	–	–
Mississippi	59	19 *	12	–	–
Missouri	75	30 *	38	–	–
Nebraska	81	25	47 *	–	–
New Hampshire	78	–	56 *	–	–
New Jersey	82	32 *	41	89	–
New Mexico	72	–	40 *	–	41
New York	78	25 *	38	74	–
North Carolina	63	29 *	28	–	–
North Dakota	84	–	–	–	57 *
Ohio	72	24 *	38	–	–
Oklahoma	72	28	46	–	55 *
Pennsylvania	73	28 *	38	–	–
Rhode Island	69	32	22 *	64	–
South Carolina	70	30 *	21	–	–
Tennessee	62	21 *	23	–	–
Texas	76	33	40 *	87	–
Utah	75	–	47 *	–	–
Virginia	71	35 *	50	76	–
West Virginia	55	31 *	19	–	–
Wisconsin	81	38 *	43	–	62
Wyoming	77	–	53 *	–	39
Guam	64	–	18	30 *	–
Virgin Islands	–	14 *	6	–	–

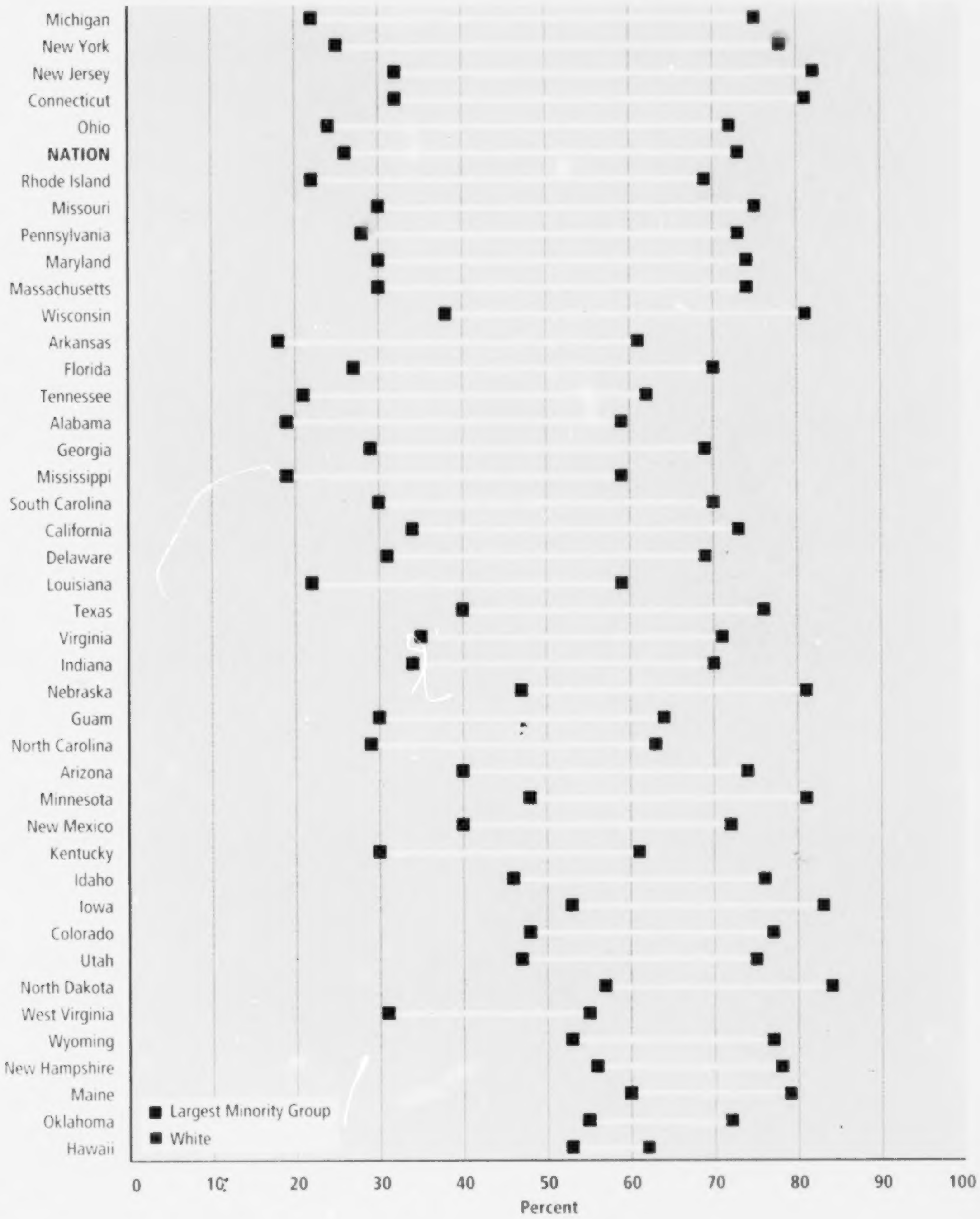
Note: * Race ethnic minority group with largest enrollment. (see Figure 2)

– Respondents too few for a reliable state estimate

Mullis et al. (1993). NAEP 1992 Mathematics Report Card for the Nation and the States (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Figure 2: **Disparity Between White and Minority Students in Percentage of Grade 8 Students Scoring at or Above Basic Level, 1992 NAEP Mathematics**



The disparity for **Michigan** is 53 percentage points—the difference between the 75 percent of white students at or above the Basic level and the 22 percent for black students.

Mullis et al. (1993). NAEP 1992 Mathematics Report Card for the Nation and the States. U.S. Department of Education (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

National Trends by Race/Ethnicity and Gender

NCES reports show overall improvement in NAEP mathematics and science scores over the decade 1982 to 1992 (Mullis et al., 1994). The national average proficiency in mathematics had statistically significant, but modest, increases at ages 9, 13, and 17 over the period; for example, the grade 4 average math proficiency scale score was 219 in 1982 and rose to 230 in 1992. In science, approximately the same size improvements were made at these age levels; for example, age 9 (grade 4) average science proficiency was at 221 in 1982 and rose to 231 in 1992.

The tables in this section summarize NAEP results by race/ethnicity and show larger rates of improvement in proficiency scores for minority students than whites from 1982 to 1992.

- In math, black students' proficiency at age 9 improved over 13 points—195 to 208—and black students' science proficiency also significantly improved—187 to 200.

A 13-point improvement on NAEP is substantial. In mathematics, 13-year-olds score 43 points higher on average than 9-year-old students. Thus, 13-point improvement for age 9 black students scores on NAEP could be interpreted as the equivalent of an improvement of more than one year of school.

Scores for Hispanic students also increased significantly in the decade; for example, at age 9, scores rose 16 points in science and eight points in math. Even though minority scores on NAEP assessments improved more than scores of whites in the 1980s, the gap in math and science proficiency between majority and minority students is still substantial.

Trends in Average Mathematics Proficiency by Race/Ethnicity, NAEP 1982 to 1992

	1982	1992
Black		
Age 9	195	208*
Age 13	240	250*
Age 17	272	286*
Hispanic		
Age 9	204	212*
Age 13	252	259*
Age 17	277	292*
White		
Age 9	224	235*
Age 13	274	279*
Age 17	304	312*

* Statistically significant difference from 1982.

NAEP trends reported on a scale of 0 to 500; trend scores are reported by age groups rather than grades.

Source: Mullis et al., 1994.

Trends in Average Science Proficiency by Race/Ethnicity, NAEP 1982 to 1992

	1982	1992
Black		
Age 9	187	200*
Age 13	217	224
Age 17	235	256*
Hispanic		
Age 9	189	205*
Age 13	226	238*
Age 17	249	270*
White		
Age 9	229	239*
Age 13	257	267*
Age 17	293	304*

* Statistically significant difference from 1982.

NAEP trends reported on a scale of 0 to 500; trend scores are reported by age groups rather than grades.

Source: Mullis et al., 1994.

- The 1992 national NAEP results in mathematics show no gender differences in average mathematics proficiency at age 9 and age 13.

The average proficiency for males is slightly higher than females at age 17 (grade 12) (Mullis et al., 1993). The trend from 1982 to 1992, in the tables below, shows females have improved NAEP scores in mathematics relative to males at all levels.

In 1992, a representative sample of students were tested to assess trends in science, although a new science assessment was not done (Mullis, et al., 1993).

- The science NAEP results show that in 1992 females continue to score lower than males at all age levels—9, 13, and 17.

The difference in NAEP 1992 science scores between males and females at age 17 is 10 points—299 vs. 289. Ten scale points is one-fourth of the 40-point difference in average scores of all 13-year-olds and all 17-year-olds, and thus the 10 points could be interpreted as a difference of one year of high school.

Trends in Average Mathematics and Science Proficiency by Gender, NAEP 1982 to 1992

Mathematics	**1982**	**1992**
Male		
Age 9	217	231*
Age 13	269	274*
Age 17	302	309*
Female		
Age 9	221	228*
Age 13	268	272*
Age 17	296	304*†

Science	**1982**	**1992**
Male		
Age 9	221	235*
Age 13	256	260
Age 17	292	299*
Female		
Age 9	221	227*†
Age 13	245	256*†
Age 17	275	289*†

* Statistically significant difference from 1982.

† Statistically significant difference from male score.

NAEP results reported on a scale of 0 to 500; trend scores are reported by age groups rather than grades.

Source: Mullis et al., 1993.

Students Taking Advanced Placement Examinations

Each year the College Board offers Advanced Placement (AP) examinations in a range of academic subjects and students receive a composite score of 3, 4, or 5 that can qualify them for college credit in the subject. Many high school students enroll in courses that follow the AP curriculum. The number of high school students in a state taking AP examinations and the proportion who receive a qualifying (passing) score, provide an indicator of high-level student achievement. Caution should be used in interpreting this indicator since AP exams represent a voluntary group of students, and states and districts may differ significantly in how students are enrolled in AP courses and apply to take the exams.

Table 4 provides state-by-state data on the percentage of grade 12 students in each state taking AP exams in calculus and in science fields of biology, chemistry, or physics; the percentage of exam-takers who receive a qualifying score, and the percentage female of all students taking the exams.

- Nationally, 4.4 percent of grade 12 students took AP calculus in 1994, a total of 107,000, up from 4 percent in 1992.
- Over 7 percent of grade 12 students took the calculus AP exam in New York, Virginia, Delaware, Massachusetts, New Jersey, South Carolina, Utah, and the District of Columbia.
- In science, 4.5 percent took an AP exam in 1994, a total of 110,000, up from 4.4 percent in 1992.
- Over 9 percent of grade 12 students took a science AP exam in New York, New Jersey, Utah, and the District of Columbia.

These totals include both public and private schools. Nationally, 80 percent of AP exams in all subjects are taken by public school students. The percentage of grade 12 students is used for statistical comparison across states—AP exams are not limited to only grade 12 students.

Scores that qualified students for college credit were awarded to 68 percent of students, nationally, in mathematics and to 64 percent of students in science (biology, chemistry, or physics). The state percentages for qualified scores in AP math varied from 42 percent of exam-takers (in Indiana, where 4 percent of students took the exam) to 84 percent of exam-takers (in North Dakota, where 1 percent took the exam).

An important feature of this indicator is measuring progress in minority and female participation in AP exams. The percentage female among students taking AP Calculus varied from 35 percent in North Dakota to 52 percent in North Carolina. The national average in 1994 was 45 percent female, which is a 2 percentage increase from 1992. The percentage of females taking AP science exams varied from 27 percent in Iowa to 54 percent in South Carolina. The national average was 34 percent female.

The math and science totals by state are reported in Table 5 according to the percentage of exam-takers who were from race/ethnic minority groups. Nationally, 26 percent of students taking AP Calculus exam were minority students, and 26 percent taking AP science exams were minority students. These statistics show no change from 1992 for minority student participation.

- States with more than 30 percent minority participation in AP Calculus were: California, Colorado, District of Columbia, Hawaii, and Texas.
- States with over 30 percent minority participation in science were: California, Maryland, District of Columbia, and New York.

States can also examine the percentage of each race/ethnic group that took AP exams in Calculus in 1994. For space purposes, only mathematics was disaggregated. Race/ethnic data by group are available for each science AP exam.

Table 4: Students Taking Advanced Placement Examinations in Mathematics and Science, 1994

	AP Calculus			AP Science*		
STATE	% of Grade 12 Students Taking Exam	% Receiving Qualified Score	% Female of Students Taking Exam	% of Grade 12 Students Taking Exam	% Receiving Qualified Score	% Female of Students Taking Exam
Dist. of Columbia	9	78	47	13	69	43
New York	8	69	46	10	73	45
Utah	8	79	38	9	74	38
New Jersey	7	72	43	9	71	42
South Carolina	7	60	51	6	54	54
Delaware	7	62	47	8	72	47
Maryland	7	73	45	7	69	44
Massachusetts	7	76	43	7	73	41
Virginia	7	64	49	6	65	47
Hawaii	6	79	47	7	76	42
Connecticut	6	77	43	7	72	43
California	6	73	45	6	67	43
Florida	6	62	47	6	37	45
Indiana	6	42	43	6	29	45
North Carolina	6	61	52	6	51	53
Georgia	6	52	48	6	43	47
New Hampshire	5	50	49	4	79	37
Illinois	5	73	46	6	74	41
Colorado	4	72	44	4	67	46
NATION	4	68	45	5	64	44
Vermont	4	63	43	5	74	52
Michigan	4	73	45	4	71	42
Rhode Island	4	70	39	4	65	40
Alaska	3	67	48	3	61	49
New Mexico	3	49	44	3	54	45
Pennsylvania	3	68	46	4	64	41
Ohio	3	68	43	3	63	43
Tennessee	3	67	45	3	65	44
Arizona	3	68	44	4	56	46
Wyoming	3	70	43	1	58	45
Wisconsin	3	71	39	2	65	37
Maine	3	55	46	3	60	38
Alabama	3	54	47	3	49	47
Nevada	3	70	43	3	55	47
Texas	3	73	45	2	58	40
Kentucky	2	54	48	3	42	52
Minnesota	2	69	47	1	66	42
Washington	2	72	39	2	71	41
Idaho	2	75	39	2	73	36
West Virginia	2	49	47	2	51	43
Missouri	2	73	44	2	68	44
Oregon	2	75	33	2	74	38
Oklahoma	2	71	41	2	60	38
Nebraska	2	69	42	1	67	39
Iowa	2	79	38	1	74	27
Louisiana	1	63	42	1	62	47
Mississippi	1	52	50	1	43	53
Kansas	1	75	46	1	65	31
Arkansas	1	63	41	1	58	45
Montana	1	62	41	1	71	34
North Dakota	1	84	35	1	74	47
South Dakota	1	79	40	1	65	38

State totals include public and private schools.

* AP Science = students taking AP Biology, Chemistry, or Physics AB or BC.

The College Board (1994). Advanced Placement Program, National and 50 States Summary Reports.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Table 5: Minority Students Taking Advanced Placement Examinations in Mathematics and Science, 1994

	AP Calculus					AP Science
STATE	% Minority of Students Taking AP Calculus	% American Indian	% Asian	% Black	% Hispanic	% Minority of Students Taking AP Science
Hawaii	80	0.3	78	1	1	77
California	53	0.4	42	2	9	49
Dist. of Columbia	34	0.3	10	17	6	35
Texas	33	0.4	20	3	10	20
Florida	30	0.4	12	6	12	28
New Mexico	29	1	8	1	19	30
New Jersey	28	0.1	22	3	3	29
Illinois	27	0.1	20	3	3	29
New York	26	0.1	19	4	4	33
NATION	26	0.3	18	4	4	26
Maryland	25	0.1	19	4	2	31
Oklahoma	24	4	14	3	3	22
Alabama	24	1	9	13	1	25
Louisiana	22	0	13	6	3	23
Virginia	22	0.1	15	5	2	24
Washington	22	0.5	19	1	1	18
Arizona	21	2	11	1	7	22
Nevada	20	1	14	1	5	21
Connecticut	20	0.1	16	2	2	19
Tennessee	19	0.3	10	8	1	20
South Carolina	18	0.1	4	13	1	16
Massachusetts	18	0.1	16	1	1	16
Kansas	17	1	14	1	1	25
Delaware	16	0.3	12	2	2	19
North Carolina	16	0.4	8	8	1	19
Alaska	16	3	11	0.4	1	8
Mississippi	15	0	6	7	2	18
Michigan	15	0.2	11	3	1	20
Arkansas	14	1	9	5	0.3	13
Oregon	14	1	11	1	2	16
Pennsylvania	14	0.1	11	1	1	14
Missouri	13	0.2	8	3	1	13
Ohio	13	0.1	9	3	1	17
New Hampshire	12	0.2	11	0.2	1	13
Indiana	11	0.1	6	3	2	12
Rhode Island	11	0	8	2	1	11
Minnesota	10	0.1	8	1	0.5	11
West Virginia	10	0	7	2	1	9
Colorado	9	1	6	1	2	16
Kentucky	8	0.1	6	1	1	6
North Dakota	8	1	5	0	1	7
Vermont	8	0	6	0	1	9
Nebraska	7	0	5	0.3	2	8
Wisconsin	7	0.1	5	0.5	1	10
Iowa	6	0	5	0.2	1	10
Idaho	6	1	3	0	1	6
Utah	5	0.2	4	0.04	1	5
Wyoming	5	0.5	3	0.5	1	3
Maine	3	0.2	1	0.5	1	2
Montana	3	1	1	0	1	3
Georgia	3	0	3	0.3	0.1	26
South Dakota	0	0	0	0	0	7

State totals include public and private schools.

% AP Science = Students taking AP Biology, Chemistry, or Physics AB or BC.

The College Board (1994). Advanced Placement Program, National and 50 States Summary Reports.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Chapter Two
Indicators of Mathematics and Science Content and Instruction

- **Elementary Class Time on Mathematics and Science**
- **Students Progressing to Three Years of High School Mathematics and Science**
- **State Graduation Requirements and Trends in Course Enrollments**
- **Course Enrollments by Race/Ethnicity, Gender, and Parents' Education**
- **Teaching Practices and Content Emphases in Instruction**

Need for Indicators

State policymakers and science and math educators need to know about curriculum content and instructional practices in schools. A system of education indicators typically focuses first on student achievement as the primary measure of the outcome of schooling. Educators would like to be able to understand differences in student achievement in terms of how and what students are taught. These kinds of indicators could help to inform efforts to improve the development of teachers's skills and to improve the design and delivery of mathematics and science curriculum.

States are developing indicators of achievement—35 states monitor and report on mathematics and science learnings using statewide assessment programs (Bond, Roeber, et al., 1994), and we also know that 30 states report achievement scores at district and school levels (CCSSO, 1994). A few states are beginning to collect and report data that show the relationship of curriculum and instruction in classrooms to student achievement. Most state indicators and accountability reports, however, have few indicators of subject content or instructional practices found in schools and classrooms.

National standards for mathematics and science emphasize the importance of curriculum that connects subject content and process skills (AAAS, 1993; NCTM, 1989; NRC, draft, 1994). Many states are now developing new state frameworks and content standards in mathematics and science that call for all students to receive instruction in challenging subject content and in learning how to solve problems, reason, and communicate in these subjects. The totals below show the number of states developing a new state framework as of the end of 1994 (Blank & Pechman, 1995). See Appendix C for a list of state frameworks and curriculum-related documents by state.

Status of State Curriculum Frameworks, 1994

	Mathematics	Science	Combined Mathematics and Science
States with a framework or curriculum-related document	32	32	10
States developing a framework	21	25	4

(N = 52: 50 states, District of Columbia, Puerto Rico)

Ideally, indicators in math and science education should help educators and policymakers to understand the relationship of curriculum content and instructional practices in mathematics and science to the academic performance of students. State education staff have often described how accurate, valid indicators of content and instruction would be useful information for feedback, planning, and staff development if the data were available and reported in a timely, regular manner.

Indicators Currently Available

CCSSO is now able to report state indicators of instructional time, course enrollments, and some teaching practices. These indicators can be used to assess patterns across the states and trends by state. They may not provide the level of depth and detail that educators desire to review how curriculum is actually implemented in classroom. However, these indicators are important and useful for several reasons. Research on patterns of student achievement in math and science has consistently shown that the amount of time in instruction and number of secondary courses students take is strongly related to achievement (Husen, 1967; Jones, L.R., Mullis, Raizen, Weiss, & Weston, 1992;

Hoffer, Rasinski, & Moore, 1995; Jones, L.V., Davenport, Bryson, Bekhuis, & Zwick, 1986; Rock, Braun, & Rosenbaum, 1985; Sebring, 1987; Walberg, 1984). The most recent NAEP results show that high mathematics proficiency is best explained by the level of mathematics courses students have completed (Mullis et al., 1993). We also know that instructional time and course taking in math and science vary widely across U.S. schools, and that they are correlated with the socioeconomic status of students in our schools (Goodlad, 1984; Horn & Hafner, 1992; McKnight et al., 1987; Oakes, 1990b; Weiss, 1994).

States have an interest in tracking the proportion of students that progress through the secondary science and mathematics curriculums to different course levels—for example, algebra 2, precalculus or chemistry, physics, AP math and science—because they indicate the proportion of students being offered harder, challenging content. The course enrollments by state also are useful for tracking how states and schools are progressing in offering opportunities for science and math to students from all race/ethnic groups and for female and male students.

Currently, some states use data from the teacher and student questionnaires that accompany the NAEP math and science assessments to inform policymakers and educators about instructional practices in their states and how they differ from other states and the nation. In this report, we show two uses of NAEP data on instructional practices: (1) NAEP data can be used to simply describe current instructional practices in a state, based on a standard set of items and consistent procedures; or (2) NAEP data can be analyzed to determine the relationship of practices to achievement.

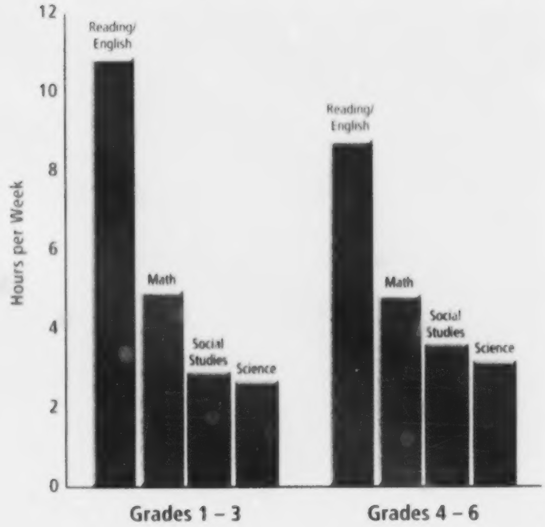
Elementary Class Time on Math and Science

Policy Issues:

- *What is the amount of class time students are taught math and science in elementary grades?*
- *Is the amount of time for math and science increasing or decreasing? What are the differences across states?*

In the Schools and Staffing Survey (SASS) for 1991, elementary schoolteachers reported the amount of time spent per week on four academic subjects: reading, math, social studies, and science. The Survey included an average of 800 teachers per state, selected to provide a state-representative sample. Figure 3 shows the average class time by subject, nationally, reported by elementary teachers for grades 1–3 and 4–6. Mathematics averages 4.8 hours per week, second in time spent to Reading/English. Science averages 3 hours per week.

Figure 3: **Average Hours per Week Spent on Core Academic Subjects as Reported by Elementary Teachers, 1991**



Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Figure 4 shows state-by-state figures on average class time on mathematics for grades 4–6. We have projected the average time reported by week to a whole school year to more clearly show the implications of differences between states.

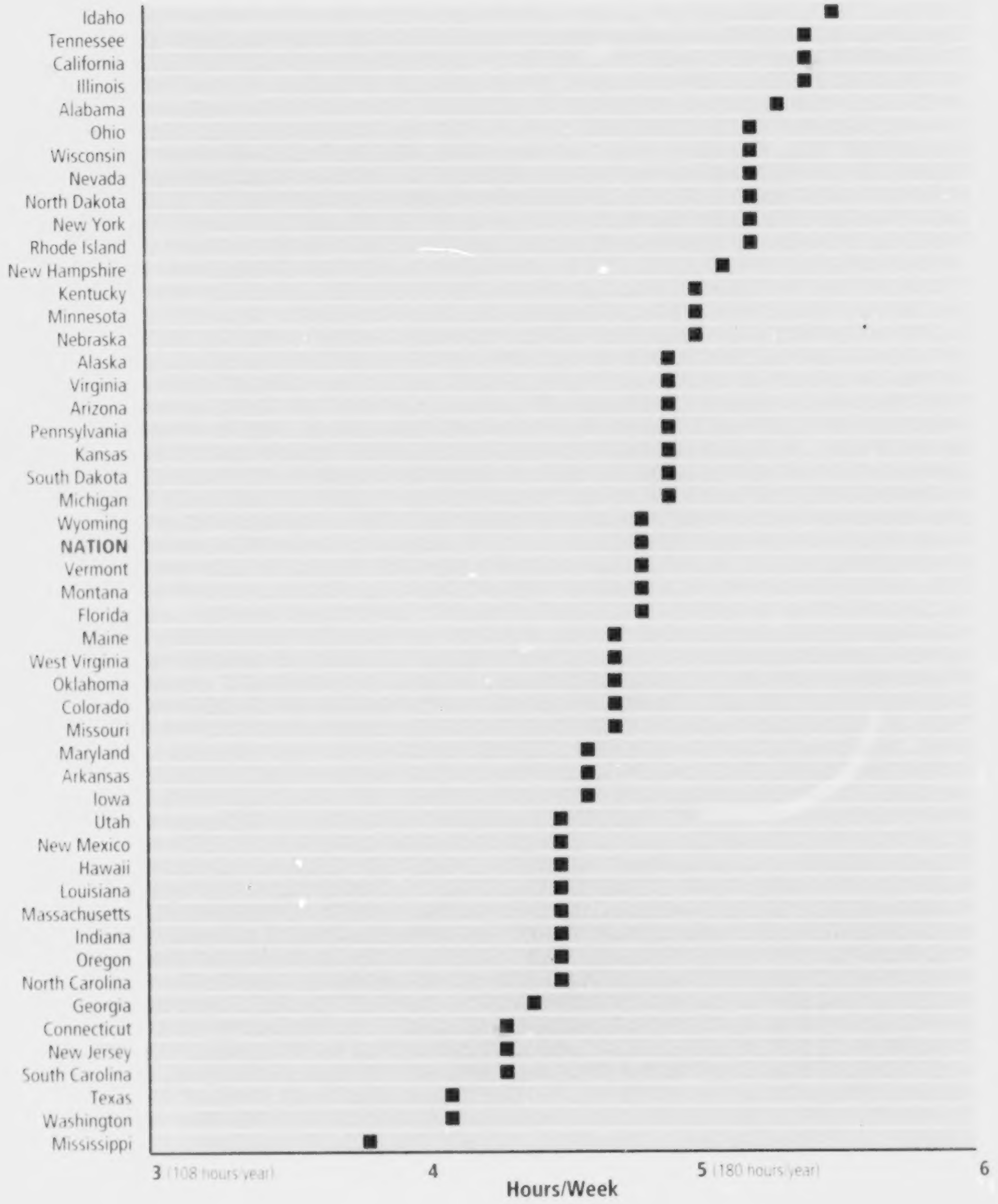
Average class time spent on mathematics in grades 4–6, as reported by teachers, varied from over 5 hours per week, or 60 minutes per day, in 11 states, including Idaho, Tennessee, California, Illinois, to 4 hours per week, or 45 minutes per day in Texas, Washington, and Mississippi. Over a year, classes in states with high average time provide 180 hours of mathematics, while classes in the states with low averages provide 144 hours of mathematics—a difference of 36 hours, or seven weeks, of classes.

Figure 5 shows average class time on science in grades 4–6 projected to a whole school year. The average time reported by teachers varied from 4 hours per week, or 45 minutes per day in Alabama, Nevada, North Dakota, and New Mexico, to 2.3 hours per week, or less than 30 minutes per day in California, New York, Iowa, and Connecticut. Projected to a year, classes in the highest states are spending 45 hours, or about 11 weeks, more time on science instruction than the classes in the states with the lowest average time.

Average class time, nationally, in grades 4–6 science increased by 10 minutes per week between 1988 and 1991, based on analysis of SASS data (NCES, 1993b). Average time in grades 4–6 mathematics did not change over the three-year period.

Considering the consistent research findings on the positive relationship of instructional time to achievement, we would expect that students in the states with significantly more time spent on mathematics and on science would show higher scores on student assessments if other differences among states are taken into consideration.

Figure 4: **Elementary Class Time on Mathematics, per Week and Year, Grades 4–6, 1991**

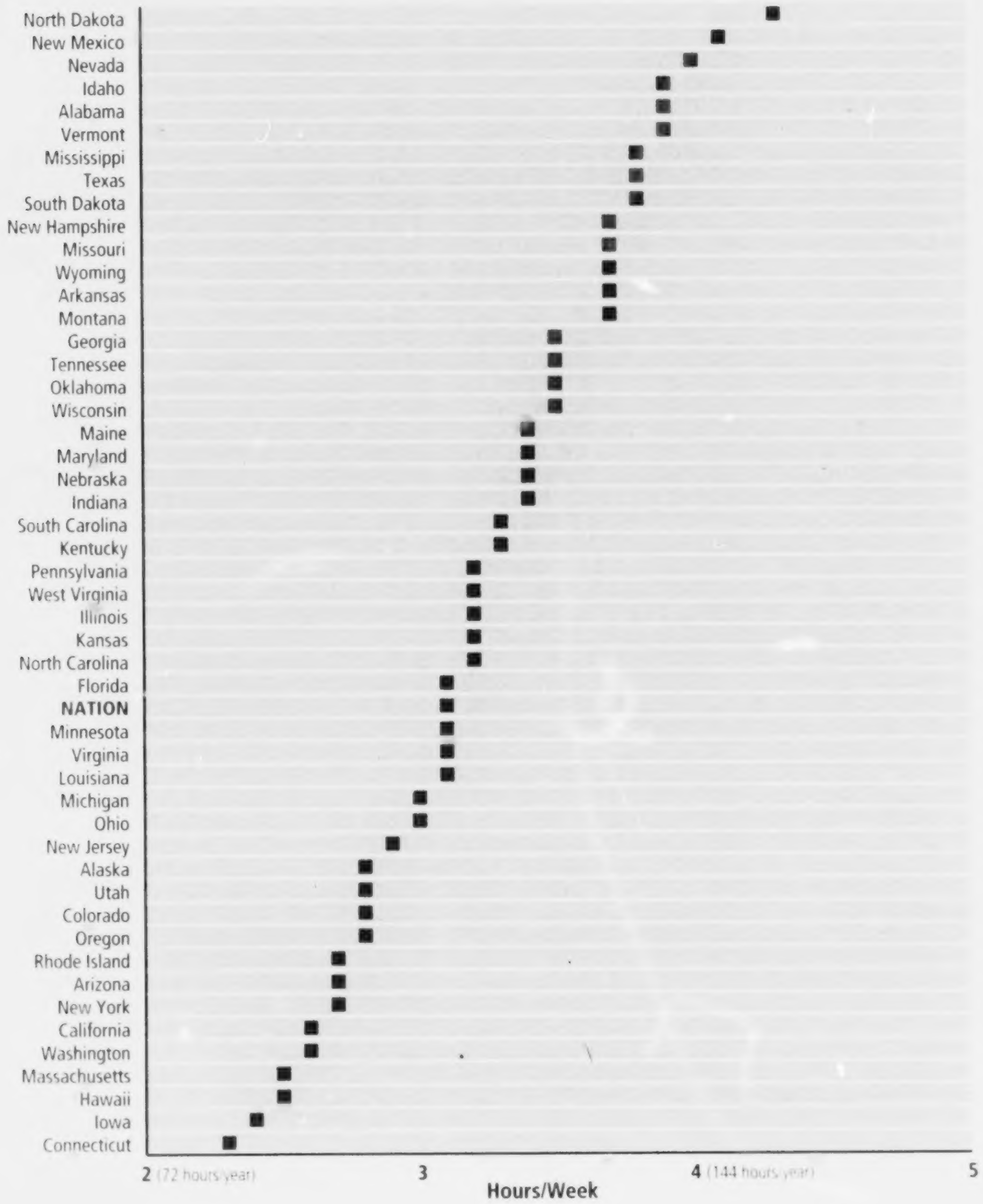


See Appendix F for table with standard errors by state.

NCES, Schools and Staffing Survey, Public School Teachers, 1990–1991.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 5: **Elementary Class Time on Science, per Week and Year, Grades 4–6, 1991**



See Appendix F for table with standard errors by state.

NCES, Schools and Staffing Survey, Public School Teachers, 1990–1991

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Students Progressing to Three Years of High School Mathematics and Science

Policy Issues:

- *What proportion of students take challenging subject content in mathematics and science, as indicated by enrollments in higher-level courses?*
- *Are state enrollments in low level, remedial courses declining?*

Students Taking Higher-Level Mathematics Courses

Table 6 reports the percentage of high school students in each state that take high school mathematics courses by graduation, based on data from the 1993–94 school year. States are ordered by the percentage of students taking algebra 2 or integrated math 3 by graduation (generally, the third year of mathematics in the high school curriculum). Many states have set three years of high school mathematics as a requirement for graduation, following the recommendations from *A Nation at Risk* (National Commission on Excellence in Education, 1983).

- The percentage of students reaching the third year of high school mathematics varies from over 75 percent (e.g., Utah, North Dakota, Nebraska, Maine) to less than 45 percent (e.g., Nevada, Delaware, Hawaii), with the national average at 60 percent.

Nationally, 95 percent of students take first-year algebra or integrated mathematics 1 by the time they graduate, as of 1994. The state percentages for algebra 1/integrated mathematics 1 include enrollments during high school, as well as in grade 8.

The percentage of students taking geometry or integrated math 2 varies by state from 85 percent (Utah, Montana, Louisiana, District of Columbia) to 50 percent in several states, with the national average at 65 percent. Two years of high school mathematics has been shown to be an important door to success in college, particularly for minority students. Analysis of college attendance and completion rates show that taking two years of high school mathematics is a strong predictor of whether minority students complete a college degree (Pelavin & Kane, 1990).

Many states and districts established a goal of increasing the proportion of students that take algebra 1, or integrated mathematics 1, as well as more advanced high school mathematics courses, to meet their graduation requirements. One approach states have used in working toward this goal is developing state curriculum frameworks for districts and schools to use in planning and organizing the mathematics curriculum. States also set specific policies—Georgia, Louisiana, and North Carolina have a state graduation requirement that students pass algebra 1, and Arkansas requires algebra 1 or applied math.

Figure 6 shows the percentage change from 1990 to 1994 in students reaching algebra 2, or integrated math 3.

- Eight states increased enrollments in algebra 2/integrated math 3 over 10 percentage points: North Dakota, Maine, Iowa, Texas, Minnesota, Kentucky, Arkansas, and New Mexico.

Trends are shown for only those states reporting data for 1990 and 1994. States were excluded that changed their course codes or definitions. Trends are reported from 1992 to 1994, as noted, for those states with consistent data codes and definitions for those two years.

An integrated mathematics curriculum for high school has been developed in several states. Figure 7 highlights the proportion of students taking integrated math or algebra 1 by state in the 20 states that collected data that make this distinction.

- In Montana, California, District of Columbia, Oregon, West Virginia, and Washington state, at least one-fifth of students taking first-level high school mathematics are enrolled in integrated math 1 as opposed to algebra 1.

For those readers who want to analyze course-taking patterns by the grade at which students take a course, Appendix C shows the enrollments in high school math level 1 and level 3 by percentage of students enrolled in grades 8, 9, 10, 11, or 12. Only a portion of the states were able to provide this level of detail.

Table 6: Percentage of Students Taking High School Mathematics at Five Levels by Graduation, 1994

STATE	% Algebra 2/ Integrated Math 3 (Level 3) (%)	% Algebra 1/ Integrated Math 1 (Level 1) (%)	% Geometry/ Integrated Math 2 (Level 2) (%)	% Trigonometry/ Precalculus (Level 4) (%)	% Calculus/ AP Calculus (Level 5) (%)
Utah	89	95+	93	42	15
North Dakota	82	95+	85	53	5
Nebraska	76	95+	80	44	12
Maine	76	93	82	43	0
Montana	69	95+	86	37	5
Missouri	68	95+	69	32	13
Mississippi	67	89	67	48	5
Iowa	67	92	77	37	12
Texas	67	93	68	37	8
Minnesota	67	87	72	41	15
Kentucky	66	90	63	31	8
Louisiana	66	95+	89	29	6
Pennsylvania	64	93	63	57	17
Massachusetts	64	92	64	43	14
Oklahoma	64	94	64	23	8
Wisconsin	62	95+	83	45	14
Connecticut	62	92	68	42	15
Tennessee	62	76	62	20	6
Arkansas	61	87	66	27	6
NATION	60	95+	65	33	10
New Mexico	60	95+	58	22	7
New Jersey	60	84	60	44	13
Idaho	60	95+	63	26	12
Ohio	57	95+	67	37	11
North Carolina	57	88	78	48	9
Wyoming	56	95+	60	27	16
Vermont	56	91	62	27	13
Alabama	55	76	54	20	9
Indiana	53	86	62	33	14
Alaska	52	83	50	23	9
Washington	52	66	61	21	11
Oregon	50	86	60	27	9
West Virginia	50	84	61	30	6
New York	49	80	59	28	13
Dist. of Columbia	49	95+	86	19	7
California	48	95+	52	24	9
Michigan	45	64	61	21	7
Nevada	44	92	52	28	5
Delaware	42	76	36	29	11
Hawaii	32	64	46	27	4
Puerto Rico	–	95+	65	9	–
Arizona	–	–	–	–	–
Colorado	–	–	–	–	–
Florida	–	–	–	–	–
Georgia	–	–	–	–	–
Illinois	–	–	–	–	–
Kansas	–	–	–	–	–
Maryland	–	–	–	–	–
New Hampshire	–	–	–	–	–
Rhode Island	–	–	–	–	–
South Carolina	–	–	–	–	–
South Dakota	–	–	–	–	–
Virginia	–	–	–	–	–

Example: 45% of **Wisconsin** students took Trigonometry/Precalculus (Level 4) prior to graduation, based on data from 1994.

– Data not available

Each state percent is a statistical estimate of course taking of public high school students by the time they graduate based on the total course enrollment in grades 9-12 in fall 1993 divided by the estimated number of students in a grade cohort during 4 years of high school. The statistical estimating method is imprecise above 95%.

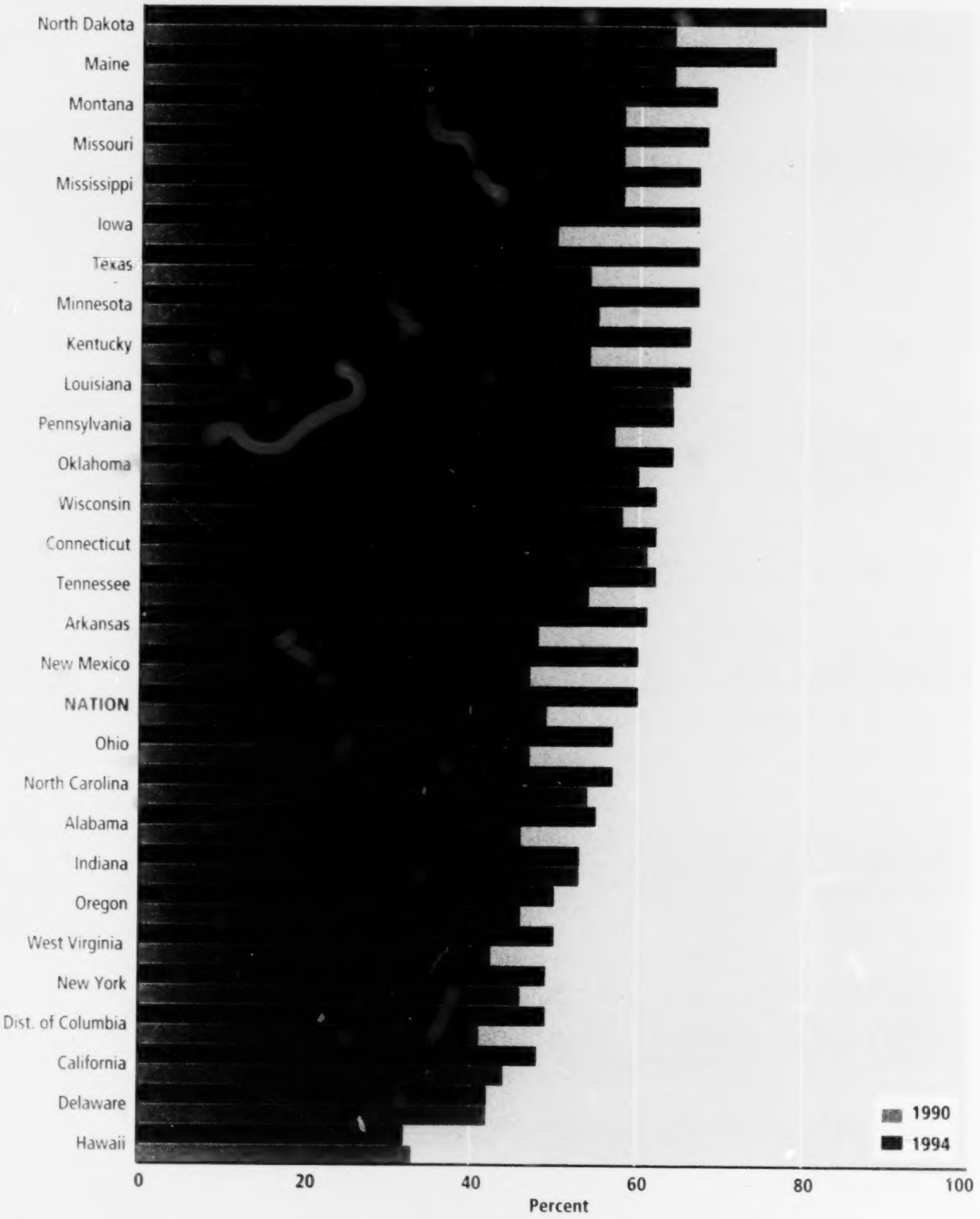
Nation = Percent of all public high school students estimated to take each course, including imputation for nonreporting states (see Appendix F.2).

Algebra 1 percentages include grade 8 Algebra 1, except Iowa, Michigan, Pennsylvania, Tennessee, Texas, and Washington.

State Departments of Education, Data on Public Schools, 1993–94 school year.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 6: **Percentage of High School Students Taking Algebra 2/Math Level 3, by Graduation, 1990 to 1994**

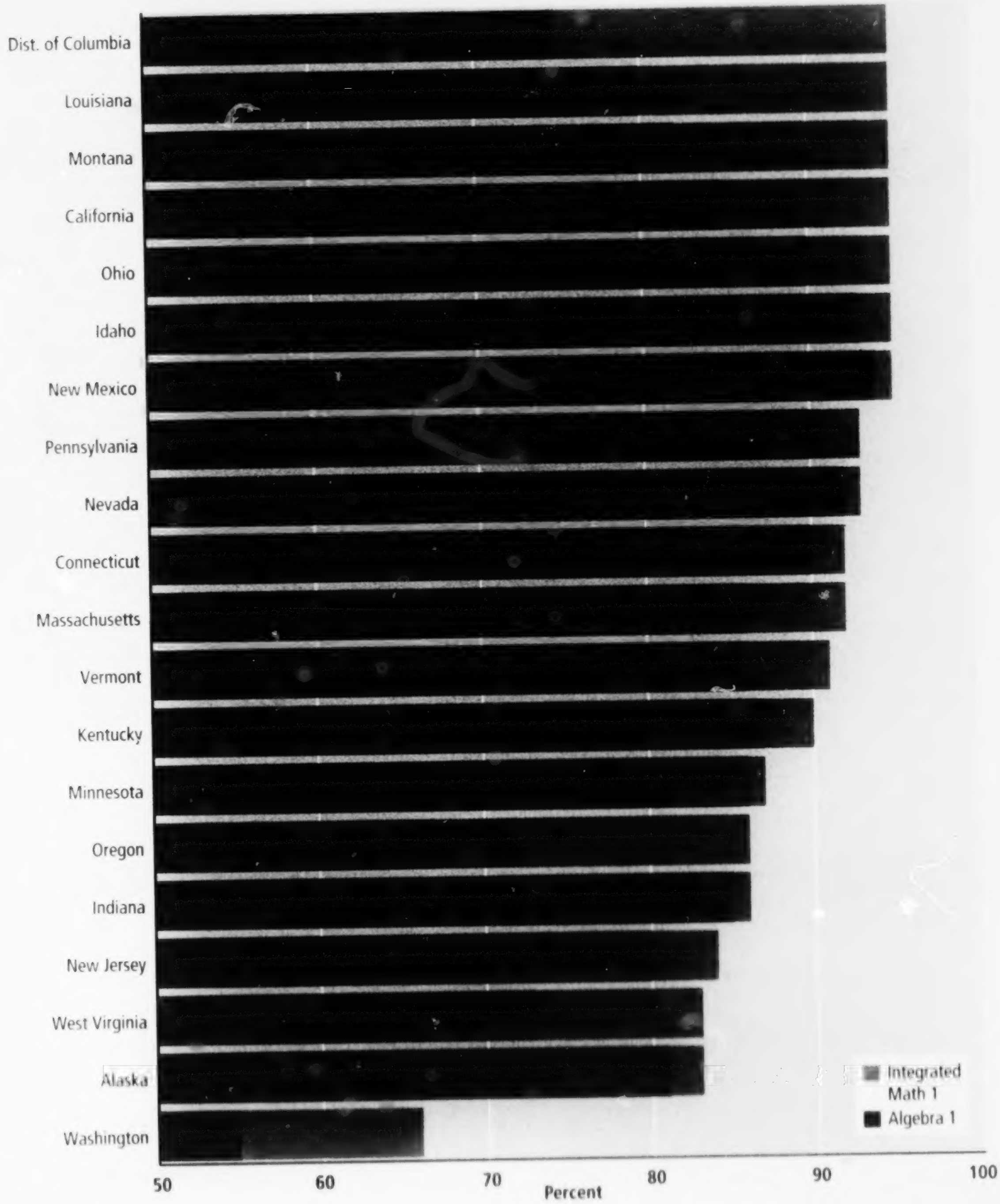


States reporting 1992 to 1994: Delaware, District of Columbia, Indiana, Montana, North Carolina, Oregon and Wisonsin.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 7: **Proportion of High School Students Taking Integrated Math 1 as Compared to Proportion Taking Algebra 1, by Graduation, 1994**



Note: Percentages represent total of Algebra 1 and Integrated Math 1 (from Table 6)

Source: State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Trend in Students Taking General or Consumer Mathematics in High School

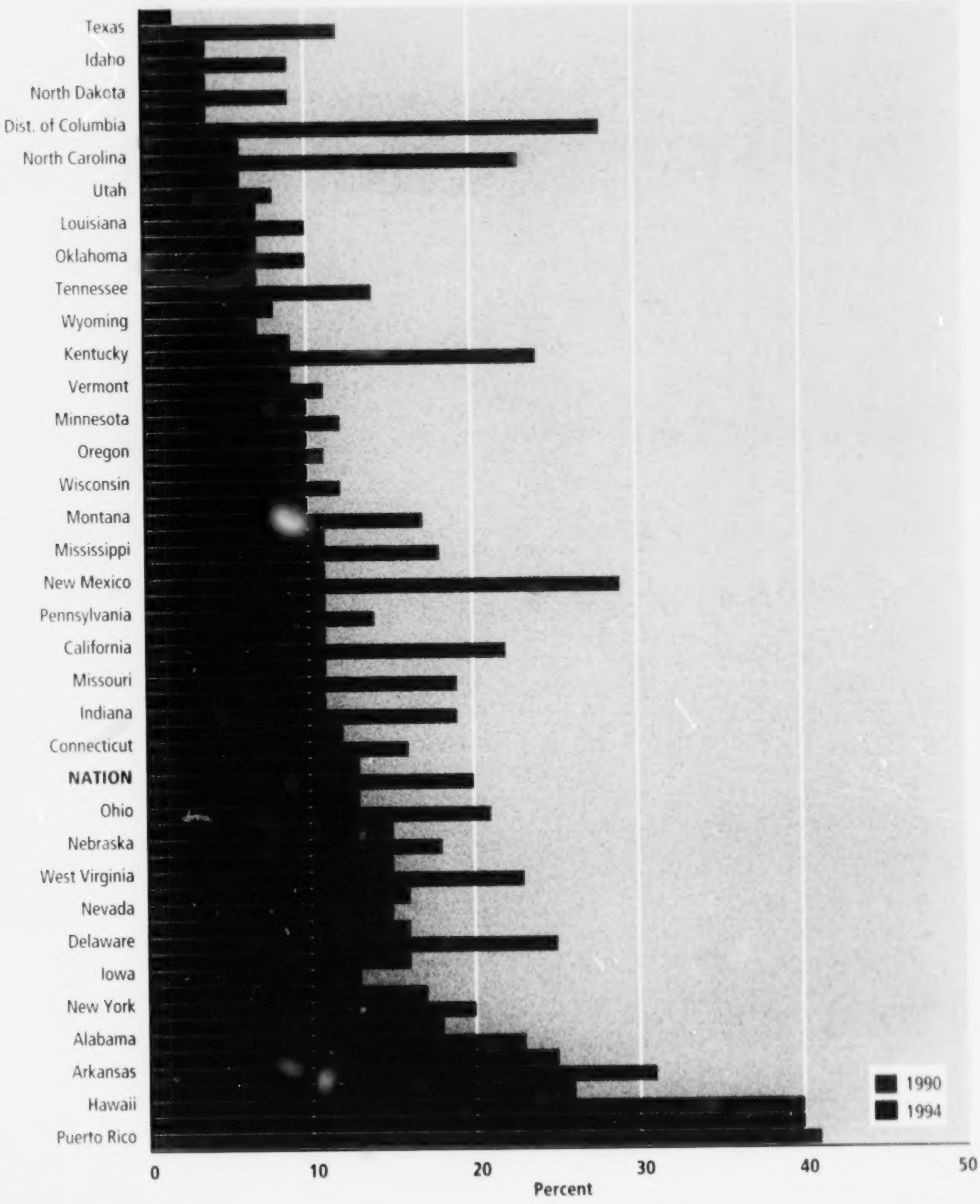
The NCTM mathematics education *Standards* (1989) recommend that all high school students receive challenging mathematics content in areas of algebra, functions, geometry, trigonometry, and statistics, as well as skills in problem solving, communication, and reasoning. Recently, state and local policies and curriculum guidance to schools have aimed at increasing the proportion of high school students beginning in the 9th grade with algebra (or integrated math 1), with the goal of increasing the proportion of students progressing to higher-level math in grades 10–12. These policies have also aimed to decrease general math and consumer math courses in the high school curriculum.

The CCSSO state indicators can help to track the effectiveness of efforts to move more students into courses with challenging content. States reported data to CCSSO on all courses taken by students in grades 7–12; and the data can be aggregated by course level, using a common course taxonomy to determine trends in math at lower versus higher levels.

- Nationally, 13 percent of students (or one out of seven) were taking general or consumer math during the 1993–94 school year, as compared to 19 percent of high school students (one out of five) four years ago.

Figure 8 shows the percentage of all high school students taking general math, consumer, or remedial math courses, computed as a percentage of all students enrolled in grades 9–12 during the 1993–94 school year. States are ordered from low to high on percentages taking lower-level math. The percentages vary from under 5 percent in Texas, Idaho, and North Dakota to over 20 percent in Hawaii, Puerto Rico, and Arkansas. Change in these enrollments can be examined for states that reported these data for 1989–90. States showing a decline in enrollments in general consumer math of over 10 percentage points include Texas, District of Columbia, Kentucky, New Mexico, and California. See Appendix C for detailed data by course.

Figure 8: **High School Students Enrolled in General or Consumer Mathematics, Percentage of Grades 9–12 Students, 1990 to 1994**



Source: State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Students Taking Higher-Level Science Courses

Table 7 shows the percentages of high school students in each state that take courses in several levels of science by graduation: chemistry, physics, and biology. These percentages are based on data from the 1993–94 school year. The states are ordered by the percentage of students that take chemistry by graduation, which we use as an indicator of the proportion of students in a state that progress to three years of high school science by graduation.

- The percentage of students taking chemistry varies from over 67 percent in Maine, District of Columbia, North Dakota, Wisconsin, and Vermont to less than 40 percent in Oklahoma, California, Alaska, Washington, and Wyoming.

It is possible for students to take three years of science without taking chemistry (e.g., two years of biology and one year of earth science); but as an indicator across states, course enrollment in chemistry is the indicator that is most consistent.

Figure 9 shows a bar graph of states rank-ordered by the proportion of students taking chemistry by graduation in 1994 and the difference from 1990. In 1994, 51 percent of U.S. students were taking chemistry by graduation, whereas 45 percent took chemistry in 1990. Six states increased chemistry enrollments more than 10 percentage points: Maine, North Dakota, Wisconsin, Nebraska, West Virginia, and Arkansas.

The statistics in Table 7 show that all states have a very high proportion of students taking first-year biology by graduation, and nationally over 95 percent of high school students take biology. In many states, the increase to two or three graduation requirements for science in the 1980s means that the typical student now takes an introductory science course, e.g., earth, physical, general, or integrated science, and a course in biology. In a few states, such as Mississippi, biology is the first science course in high school.

Physics enrollments vary by state from over 40 percent (Maine, Vermont) to under 15 percent (Oklahoma). The national average is 22 percent of students taking physics by graduation. This percentage is an estimate of the proportion of students taking four years of high school science.

Appendix C gives enrollments by state on introductory science courses, "general" versus "applied" biology and chemistry, and enrollments in advanced/second year courses.

Several states now have a substantial percentage of students taking an integrated or coordinated science curriculum, often starting in grade 7 and continuing through grade 10 or grade 12. A *coordinated* science curriculum treats the disciplines of biology, chemistry, physics and earth/space science individually and equitably and focuses on an overarching idea in the sciences that can be explained in terms of all four disciplines. An *integrated* science curriculum intentionally blurs the traditional disciplinary lines and treats science as a whole, under the assumption that the disciplines should not be separated in the secondary curriculum (California Scope, Sequence & Coordination Project, 1995).

The data show that Kentucky and West Virginia had over 10 percent of grades 9–12 students enrolled in integrated/coordinated science in 1993–94, which means that over 40 percent of students would take an integrated/coordinated science course by graduation. (California has a substantial number enrolled in integrated and coordinated science, and specific counts will be available for 1995–96.) Enrollments by state are in Appendix C.

Table 7: Percentage of Students Taking High School Science at Three Levels by Graduation, 1994

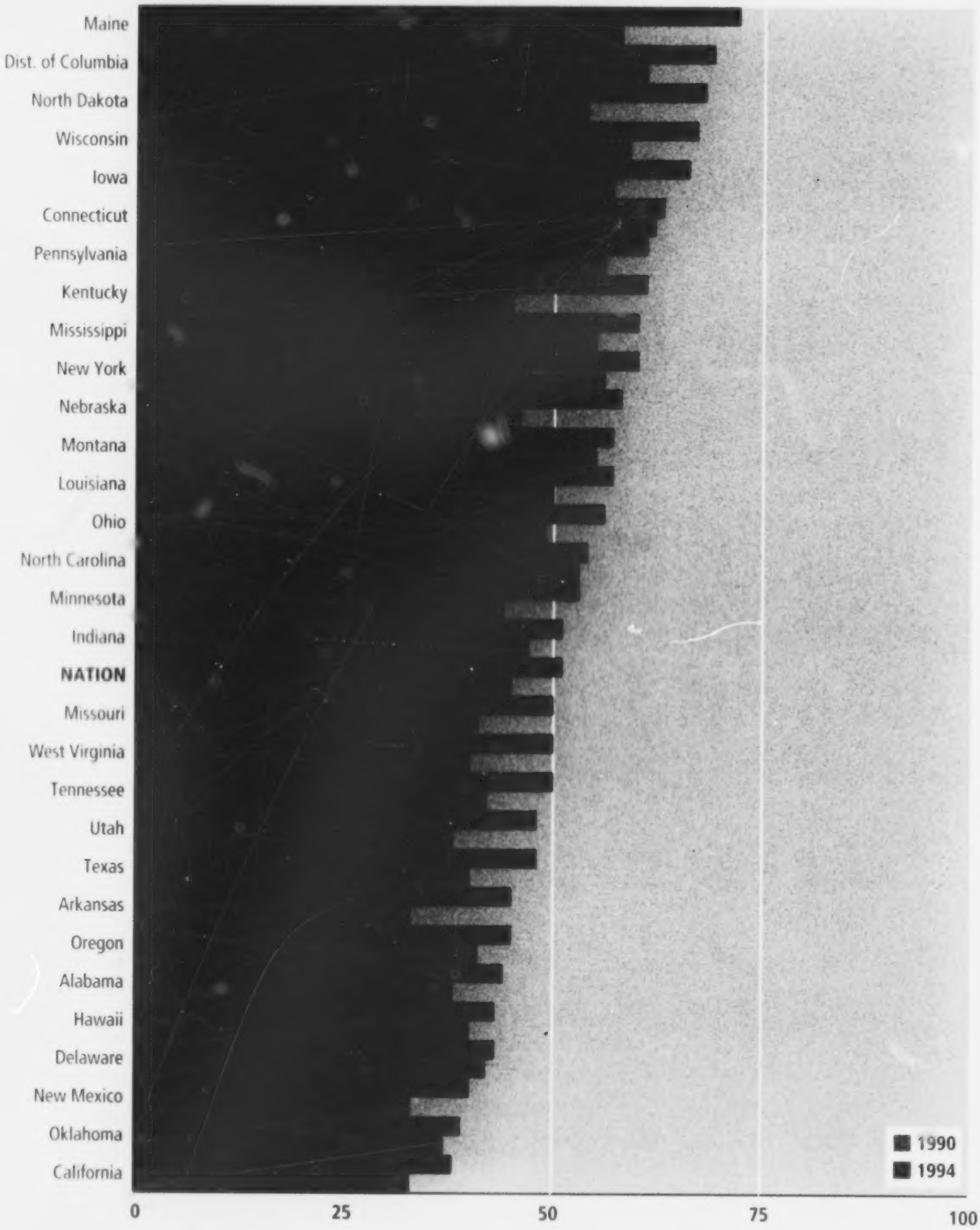
STATE	Chemistry 1st Year (%)	Physics 1st Year (%)	Biology 1st Year (%)
Maine	72	52	95+
Dist. of Columbia	69	20	95+
North Dakota	68	31	95+
Wisconsin	67	31	95+
Vermont	67	40	95+
Iowa	66	33	95+
Connecticut	63	36	95+
Massachusetts	63	34	91
Pennsylvania	61	31	95+
Kentucky	61	17	95+
Puerto Rico	61	34	82
New Jersey	60	28	88
Mississippi	60	17	95+
New York	60	31	95+
Nebraska	58	33	95+
Montana	57	27	95+
Louisiana	57	23	95+
Ohio	56	23	95+
North Carolina	54	16	94
Minnesota	53	26	86
NATION	51	22	95+
Indiana	51	22	95+
Missouri	50	19	95+
West Virginia	50	15	88
Tennessee	50	17	88
Utah	48	30	95+
Texas	48	16	95+
Nevada	45	17	95+
Arkansas	45	20	92
Oregon	45	22	85
Alabama	44	15	95+
Michigan	43	22	66
Hawaii	43	25	90
Delaware	43	19	95+
Idaho	43	15	95+
New Mexico	40	16	95+
Oklahoma	39	13	94
California	38	18	84
Alaska	38	16	84
Washington	38	16	75
Wyoming	34	17	78
Arizona	–	–	–
Colorado	–	–	–
Florida	–	–	–
Georgia	–	–	–
Illinois	–	–	–
Kansas	–	–	–
Maryland	–	–	–
New Hampshire	–	–	–
Rhode Island	–	–	–
South Carolina	–	–	–
South Dakota	–	–	–
Virginia	–	–	–

Note: – Data not available.
See Table 6 for computation of percentages (also see Appendix F.2).

Source: State Departments of Education, Data on Public Schools, 1993–94 school year.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 9: **Percentage of High School Students Taking Chemistry, by Graduation, 1990 to 1994.**



Source: State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

State Graduation Requirements and Trends in Course Enrollments

Policy Issues:

- *Have enrollments in higher level courses increased in the 10 years since many states raised requirements?*
- *Do states with policies setting higher course requirements for graduation have higher rates of course taking in science and mathematics?*

Current efforts toward science and math reform are aimed at high standards for the content of what students know and can do. State policies aimed at raising requirements for time of instruction or number of courses have recently been viewed as insufficient to provide strong incentives for improving instruction or for determining the effectiveness of curriculum. Even though content and performance standards are currently the favored approach to education reform, it is still important to monitor and report on the effects of major policy initiatives, such as raising course requirements, because such initiatives continue to be used widely as a strategy for encouraging higher-level content for more students.

In the 1980s, over 40 states raised the number of credits in science and mathematics required for graduation (Blank & Espenshade, 1988; Blank & Dalkilic, 1992). National trends on course taking, reported from national sample surveys of high school transcripts, indicate that enrollments in science and mathematics have risen significantly from 1982 to 1992 (NCES, 1994a). For example:

- 37 percent of high school graduates in 1982 took algebra 2; by 1992, 56 percent of graduates took algebra 2;
- 32 percent of graduates took chemistry in 1982; by 1992, 56 percent of graduates took chemistry.

The initial two Council reports on state science-mathematics indicators (1991, 1993) analyzed course enrollments according to groups of states with similar course credit requirements. The results showed that the states with the highest requirements did have higher overall course enrollments in science and mathematics, but the difference was smaller at the level of advanced courses. A 1993 study of district and school implementation of increased state requirements showed that students were taking more mathematics and science courses in high school, and key courses such as algebra, biology, and chemistry did not have their curriculum content reduced as a result (Porter, et al., 1993). Now, with the 1995 Council report, it is possible to track the amount of change in course enrollments in relation to an individual state's requirements.

Change in Percent of Students Taking Mathematics and Science by Graduation: 1982 to 1992 (From National Transcript Studies)[1]

	1982 (%)	1992 (%)
Geometry	48	70
Algebra 2	37	56
Trigonometry & Precalculus	18	38
Calculus	6	16
Biology	79	93
Chemistry	32	56
Physics	14	25

Source: NCES, 1994a.

Table 8 shows change from 1990 to 1994 in percentages of high school students taking higher-level mathematics—geometry (level 2) through calculus (level 5)—according to a state's graduation requirements. Among the nine states that had higher math requirements in 1990, all nine states increased the percentage of students taking higher-level math courses from 1990 to 94, with increases from 1 percent to seven percentage points (Arkansas and Connecticut). In 1994, the high-requirement states had from 36 to 48 percent of students enrolled in higher-level math.

Among the 20 states requiring two credits in 1990, 18 states increased the percentage of students in higher-level math over four years. The change over four years varied from -5 to +12 percent, and the percentage enrolled in higher-level math in 1994 varied from 27 percent (Delaware) to 48 percent (Montana). In the third column, we show the proportion of students in each state taking mathematics at any level in 1993-94. The median for high-requirement states is 89 percent of students taking mathematics, while the median for two-credit states is 82 percent.

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[1] These statistics are based on a national sample of graduates' transcripts, and they differ slightly from the national figures reported in Tables 6 and 7, which are based on state totals.

Table 8: Change in Higher-Level Mathematics Enrollments and State Graduation Requirements, Percentage of Grades 9–12 Students, 1990 to 1994

STATE **By Requirements** 2.5 to 3 Credits (as of 1990)	**% Students Taking Math at Level 2–5, 1994**	**Change 1990 to 1994: Math Levels 2–5**	**% Students Taking Math (any course), 1994**
Arkansas	38	+7	89
Connecticut	45	+7	95
Kentucky	40	+5	89
Louisiana	44	+1	89
New Jersey	43	–	91
New Mexico	36	+6	82
Pennsylvania	48	+2	99
Texas	41	+6	89
Vermont	39	+2	80
2 Credits (as of 1990)			
Alabama	32	+4	79
Alaska	32	–	71
California	32	+3	76
Delaware	27	-1	71
Dist. of Columbia	40	+10	87
Hawaii	26	+5	84
Idaho	39	+1	78
Indiana	39	+6	82
Maine	45	-5	66
Mississippi	43	+5	88
Missouri	43	+7	89
Montana	48	+7	89
Nevada	32	+3	82
New York	36	+2	92
North Carolina ('94–3 credits)	45	+8	85
North Dakota	56	+12	93
Ohio	41	+5	86
Oklahoma	38	+4	82
Oregon	36	+4	81
Tennessee ('94–3 credits)	36	+8	65
Utah	59	–	99
Washington	35	–	72
West Virginia	36	+6	85
Wisconsin	49	+2	95
Local Board Policies			
Iowa	47	+4	94
Massachusetts	45	–	88
Michigan	32	–	63
Minnesota	48	+7	78
Nebraska	52	–	99
Wyoming	39	–	72
NATION	39	+5	86

Note: Vermont, Delaware, Maine, Nevada, Oregon, Wisconsin—change from 1992 to 1994.

Source: State Departments of Education, Data on Public Schools.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Table 9 shows the trends in enrollments in higher-level science courses according to state graduation requirements. Among the four states requiring 2.5 to three credits in 1990, all four increased the percentage of students taking higher-level science–chemistry, physics, or advanced second-year courses–from 1990 to 1994. For example, Arkansas' science enrollments increased seven percentage points, while Louisiana increased 3 percent. The high-requirement states had from 18 to 31 percent of students enrolled in higher-level science in 1994.

For the 23 states requiring two credits in 1990, 18 states increased the percentage of students in higher-level science over four years. The change over four years varied from -1 to +12 percent, and the percentage enrolled in higher-level science in 1994 varied from 15 percent (Alaska) to 41 percent (Mississippi). In the third column, we show the proportion of students in each state taking science at any level in 1993–94. The median for high-requirement states is 88 percent of students taking science, while the median for two-credit states is 75 percent.

The group of seven states that rely on local board policies on graduation requirements have enrollments that equal enrollments in states with high state requirements. However, local district policies often exceed state requirements (NCES, 1993b). States such as Iowa, Minnesota, and Nebraska may have local requirements that lead to high rates of science and mathematics course taking.

The trends analysis of change from 1990 to 1994, reported in this section, is based on state requirements as of 1990. As of 1995, state policies show the following totals among the 50 states and the District of Columbia (see Appendix C for policies by state):

- Sixteen states require three credits of mathematics, and ten states require three science credits.
- Two states require two credits of mathematics and science plus one additional credit in mathematics or science.
- Twenty-six states require two mathematics credits, 30 states require two science credits, and two states require one credit in science.
- Seven states leave graduation requirements to local districts.
- Fifteen states have an advanced or honors diploma with higher mathematics credit requirements, and 11 require higher science credits.

This brief summary of CCSSO's analysis of course enrollments by state policies could be elaborated further. States may want to analyze enrollments by local requirements, or, enrollments could be analyzed by other policy differences within states, such as integrated science or mathematics curriculum vs. traditional sequence of courses.

Table 9: Change in Higher-Level Science Enrollments by State Graduation Requirements, Percentage of Grades 9–12 Students, 1990 to 1994

STATE	% Students Taking Chemistry, Physics, Advanced Science, 1994	Change 1990 to 1994: Chemistry, Physics, Adv.	% Students Taking Science (any course), 1994
2.5 to 3 Credits (as of 1990)			
Arkansas	18	+7	78
Louisiana	21	+3	88
Pennsylvania	31	+4	91
Vermont	31	+5	89
2 Credits (as of 1990)			
Alabama	22	+4	75
Alaska	15	–	65
California	18	+3	62
Connecticut	34	+4	86
Delaware	17	1	65
Dist. of Columbia	24	+8	74
Hawaii	19	1	75
Idaho	17	0	73
Indiana	27	+3	75
Kentucky	29	+6	80
Maine	28	0	80
Mississippi	41	+6	82
Missouri	30	+3	86
Nevada	22	0	72
New Jersey	27	–	74
New Mexico	18	4	66
New York	26	+2	86
North Carolina ('94 – 3 credits)	24	+8	78
North Dakota	37	+12	96
Oklahoma	24	+11	76
Oregon	21	+2	72
Tennessee ('94 – 3 credits)	22	+6	71
Texas	20	+3	71
Utah	33	–	99
Washington	20	–	59
West Virginia	26	+5	83
Wisconsin	32	+2	92
1 Credit or Local Board Policies			
Iowa	27	+4	88
Massachusetts	31	–	82
Michigan	15	–	55
Minnesota	30	+7	66
Montana (1 credit, '94 – 2)	28	+4	82
Nebraska	30	–	98
Ohio (1 credit)	23	+3	75
Wyoming	18	–	64
NATION	26	+5	80

Vermont, Delaware, Maine, Nevada, Oregon, Wisconsin—change from 1992 to 1994

State Departments of Education, Data on Public Schools.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Course Enrollments by Race/Ethnicity, Gender, and Parents' Education

Policy Issues:

- *Are minority students increasing their participation in higher-level science and mathematics?*
- *Is the gender gap closing in higher level science and mathematics?*
- *Are science and mathematics opportunities increasing for students from lower socioeconomic status backgrounds, as well as those from higher status backgrounds?*

Reforms in science and math education aim to increase opportunities among female and male students, and among minority and white students. Many states are trying to improve the experience of *all* students with doing mathematics and science, and to raise student confidence by helping them reach challenging levels of coursework. The goal of efforts toward equity is to prepare student for further study or to apply knowledge in careers. Course enrollments show patterns of progress in science and mathematics for females, minorities, and students from lower SES families. This progress is also important because we know that opportunities represented by course-taking levels are strong predictors of student learning in mathematics and science.

Course Enrollments by Race/Ethnicity

National high school transcripts studies conducted by NCES are useful for analyzing trends in math and science course-taking by student race/ethnicity and by student gender (NCES, 1994a) We have selected algebra 2 and chemistry to trace minority students' progress as compared to that of white students. The national averages show that minority students are making some progress in participation in higher-level mathematics and science courses.

Race/Ethnic Differences in Students taking Algebra 2 and Chemistry, 1982 to 1992

	Percent Taking Algebra 2 by Graduation	
Student Race/Ethnicity	**1982**	**1992**
White	41	59
Black	26	41
Hispanic	23	47
Asian	55	61
American Indian	20	42

	Percent Taking Chemistry by Graduation	
Student Race/Ethnicity	**1982**	**1992**
White	35	58
Black	23	46
Hispanic	17	43
Asian	52	67
American Indian	34	33

Source: NCES, National Transcript Studies, 1994a.

- The enrollment of black students taking algebra 2 increased significantly over the 1982 to 1992 period—from 26 to 41 percent of graduates. At the same time, however, the white-black gap in participation widened by three percentage points over the decade. Hispanic and American Indian students made the largest increases in algebra 2 enrollments—with both groups' enrollments doubling over 10 years. Asian American students continue to enroll in Algebra 2 at a higher rate than any other group—61 percent in 1992.
- In science, chemistry enrollments increased significantly from 1982 to 1992 for all groups, except American Indian students. Over the ten years, Black and Hispanic enrollments in chemistry doubled over 10 years—23 to 46 percent, 17 to 43 percent; white enrollments increased over 20 percentage points, and Asian American enrollments increased by 15 points.

Race/Ethnicity by State

In 1993–94, CCSSO asked states, for the first time, to report course enrollments by student race/ethnicity. Seven states now have education data systems based on student-level records; these states were able to aggregate and report enrollments by race/ethnicity (Arkansas, Connecticut, District of Columbia, Idaho, North Carolina, Ohio, Texas). The state percentages by race/ethnicity, shown in Table 10, can be compared with the overall student membership by race/ethnicity (K–12) in Appendix A. For example, in Arkansas, 25 percent of students in public schools are black, while 15 percent of students taking chemistry and 15 percent taking algebra 2 are black students. Connecticut's students are 12 percent black, compared to 8 percent of black students taking chemistry and 9 percent taking algebra 2. Across the eight states, the pattern is 5 to 6 percent fewer blacks taking these courses than the percentage of blacks enrolled in the schools. In Connecticut and Texas, enrollments of Hispanics in these courses are 5 percent below the Hispanic membership in public schools. These results provide a level of detail about indicators that makes the data more applicable to the needs of policymakers and program planners in states and school districts.

Table 10: **Race/Ethnic Differences in Students Taking Chemistry and Algebra 2/Integrated Math 3 by Graduation, 1994**

Percent Taking Chemistry by Graduation

STATE	All Students	Black	Hispanic	Asian	American Indian	White
Arkansas	45	28	45	45	45	50
Connecticut	63	39	23	94	32	72
Dist. of Columbia	69	68	58	99	69	52
Idaho	43	43	17	43	17	44
North Carolina	54	41	54	99	54	59
Ohio	56	37	56	99	56	59
Texas	48	34	34	96	48	60

Percent Taking Algebra 2/Integrated Math 3 by Graduation

STATE	All Students	Black	Hispanic	Asian	American Indian	White
Arkansas	61	38	87	87	61	68
Connecticut	62	43	28	93	31	70
Dist. of Columbia	49	46	33	99	49	61
Idaho	60	60	48	60	60	61
North Carolina	57	42	57	99	29	64
Ohio	57	49	57	57	57	58
Texas	67	53	50	99	67	82

Source: State Departments of Education, Data on Public Schools, 1993–94 school year.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Course Enrollments by Gender

National transcript data show that from 1982 to 1992 gender differences in higher-level math and science course enrollments have declined (NCES, 1994a). The percentages for the two years show that in 1992 some courses had more female students enrolled than males, for example, algebra 2. In science, more females now take chemistry by graduation (57 vs. 54 percent), while male students still have significantly higher enrollments in physics (28 vs. 21 percent).

Higher-Level Mathematics and Science by Gender, 1982 to 1992

	1982		1992	
	Female (%)	Male (%)	Female (%)	Male (%)
Algebra 2	36	38	58	54
Trigonometry & Precalculus	17	19	38	38
Calculus	5	6	15	16
Chemistry	31	32	57	54
Physics	9	18	21	28

Source: NCES, National Transcript Studies, 1994a.

Gender by State

In our first state science-math indicators report, CCSSO reported that in most states where data were available by student gender, enrollment rates were about the same for males and females up through first-year chemistry and second-year algebra; and males had higher enrollments in advanced mathematics and advanced physical sciences (Blank and Dalkilic, 1991). In analyzing trends since 1990, we focus on the higher levels of math and science; and overall the trends are toward higher rates of female enrollments in all higher-level courses.

In 1994, a total of 19 states reported course taking in math and science by gender. Table 11 shows trends by state on the percentage of females among students taking algebra 2 (math level 3) and trigonometry or precalculus (level 4).

- Seventeen states (of 19 reporting) had more females than males taking algebra 2/integrated math 3 in 1994, varying from a 2 percent difference (Idaho, Ohio, Washington, Wyoming) to 20 percent difference (District of Columbia).

At level 4 math (trigonometry/precalculus courses), nine states had more females enrolled, and six states had more males enrolled. The percentage of females (vs. males) taking higher-level mathematics has increased since 1990 in 12 of 16 states reporting trend data. For example, in Alabama and Nevada, the percentage female enrolled in level 4 math went up six percentage points in four years.

Table 11 also shows trends in higher level science by gender.

- Sixteen (of 19) states have more females taking chemistry than males, as of 1994, varying from a 4 percent difference (Iowa, Massachusetts, Puerto Rico, Washington) to 14 percent difference (District of Columbia, North Carolina).

Eighteen states (of 19) have more males than females taking physics. From 1990 to 1994, the proportion female among students taking physics increased in 12 (of 16) states, with increases from 1 to 6 percentage points. The proportion female of students taking chemistry increased in 13 (of 16) states, with the increases from one to four percentage points.

Table 11: Gender Differences in Students Taking Higher Mathematics and Science Courses, 1990 to 1994

MATHEMATICS

STATE	% Female of Students Taking Algebra 2/Integrated Math 3, 1994	% Change Female 1990 to '94	% Female of Students Taking Trigonometry/ Pre-Calculus, 1994	% Change Female 1990 to '94
Arkansas	55	+1	55	+6
California	52	+1	51	+2
Connecticut	52	+1	50	2
Dist. of Columbia	60	+1	61	-1
Idaho	51	+4	49	+1
Iowa	52	0	49	+2
Massachusetts	52	–	52	–
Nevada	53	+1	50	+6
North Carolina	55	-1	55	+1
Ohio	51	0	50	0
Pennsylvania	52	1	52	+2
Puerto Rico	–	–	54	0
Texas	52	–	51	–
Utah	50	-1	47	+1
Vermont	53	+4	48	-2
Washington	51	–	48	–
West Virginia	56	1	52	+2
Wisconsin	52	+1	50	+4
Wyoming	51	-1	48	+1

SCIENCE

STATE	% Female of Students Taking Chemistry, 1994	% Change Female 1990 to '94	% Female of Students Taking Physics, 1994	% Change Female 1990 to '94
Arkansas	55	+3	45	+2
California	53	+2	46	+4
Connecticut	53	+4	42	+6
District of Columbia	57	0	60	-3
Idaho	49	-2	37	+6
Iowa	52	+1	43	+3
Massachusetts	52	–	43	–
Nevada	54	+3	44	+4
North Carolina	57	1	47	+2
Ohio	53	+1	43	+1
Pennsylvania	53	1	49	+4
Puerto Rico	52	0	54	0
Texas	53	–	43	–
Utah	49	+3	40	+7
Vermont	53	+2	45	+2
Washington	52	–	41	–
West Virginia	56	2	42	0
Wisconsin	53	+1	45	+5
Wyoming	50	+2	32	-4

Note: – Data not available.
North Carolina, Ohio, Puerto Rico, Utah, Vermont — change from 1992 to 1994.

Source: State Departments of Education, Data on Public Schools.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Science and Math Enrollments by Parents' Education

A question that is frequently asked by educators and policymakers is how student performance in mathematics, science, and other subjects is related to students' home and community background, often called socioeconomic status (SES). Seldom do we have good data that can be reliably related to student background. Statistics reported in the NCES *Condition of Education* report (1994a) provide reliable national trend data on course enrollments in mathematics and science by the level of parents' education. The data are from transcripts of representative national samples of high school graduates collected in 1982 and 1992.

Figure 10 shows that the largest increases in algebra 2 and chemistry enrollments from 1982 to 1992 were among students whose parents did not graduate from high school—24 percentage points rise in algebra 2 enrollment and 31 points increase in chemistry, as well as among students whose parents highest level was high school graduate—increase of 22 percentage points in both subjects.

These findings on trends in course enrollments in mathematics and science indicate that higher level mathematics and science is being taken by a broader range of high school students than 10 years ago in that more students from families with lower levels of education are taking chemistry and algebra 2. It is possible that state policies setting higher course requirements have increased participation of lower SES students in high school mathematics and science. Hoffer et al. (1995) report that higher course taking improves student achievement for students from all SES groups.

Another way to analyze course-taking differences is by comparing districts within states. Appendix E shows course enrollments for large urban districts participating in the NSF Urban Systemic Initiatives (USI) program.

Figure 10: **Parents' Education Level and Percentage of Students Taking Algebra 2 and Chemistry, 1982 to 1992**

	Percent Taking Algebra 2 by Graduation	
Parents' Education Level	**1982**	**1992**
Less than high school	28	52
High school graduate	33	55
Some college	44	53
College graduate	53	59

	Percent Taking Chemistry by Graduation	
Parents' Education Level	**1982**	**1992**
Less than high school	22	53
High school graduate	26	54
Some college	38	55
College graduate	52	58

NCES, Data Compendium for the NAEP 1992 Mathematics Assessment of the Nation and the States.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Teaching Practices and Content Emphases in Instruction

Policy Issues:

- *To what extent are teaching practices consistent with national standards on teaching in mathematics and science?*
- *Are there differences in mathematics instruction, teacher preparation, or use of resources that are related to higher mathematics proficiency?*
- *What factors predict student proficiency on NAEP, taking into consideration student background?*

The NCTM curriculum standards and teaching standards (1989, 1991) and NRC science standards (1994) recommend approaches to instruction that increase students' direct involvement in learning through doing mathematics and science and constructing ways of reasoning and solving problems. The CCSSO indicators focus on state-level results from 1992 NAEP (Mullis, et al., 1993) that show the extent to which grades 4 and 8 mathematics classes include instructional practices that are consistent with NCTM standards. State-level data on science practices are not currently available; the 1996 NAEP in science will provide these data. We report national-level indicators of science instructional practices from a recent survey of teachers (Weiss, 1994).

Elementary Math Instructional Practices

Table 12 shows the percentage of grade 4 students by state that experience four types of instructional practices, at least weekly: (1) work in small groups, (2) write reports or do mathematics projects, (3) use manipulatives (rulers, blocks, or shapes), and (4) use calculators in class. The percentages reflect practices reported by teachers – for example, teachers of 60 percent of Alabama's grade 4 students report that students work in small groups at least weekly. These same practices were also reported by students, and were generally lower. For example, 37 percent of students in Alabama say they work in small groups at least weekly.

- ***Small Groups.*** Results from the NAEP teacher questionnaire show that 65 percent of grade 4 students work in small groups each week, with states varying from under 45 percent of students in Arkansas and North Dakota to over 70 percent of classes in Maryland, Colorado, California, and Maine.
- ***Math Reports or Projects.*** Only 1 percent of grade 4 teachers in the nation reported using weekly projects or reports, and 80 percent reported never or hardly ever using them. A few states had over 5 percent of classrooms doing projects weekly, e.g. California, Maryland.
- ***Math Manipulatives.*** Nationally, almost half of grade 4 classrooms (46 percent) were using manipulatives weekly. Over 60 percent of students in Connecticut and Maryland used them weekly, while less than 25 percent of students had weekly use in Arkansas, North Dakota, and Oklahoma.
- ***Calculators.*** Eighteen percent of grade 4 students across the United States reported that they use calculators in math class weekly. States varied widely, from over 35 percent in Hawaii, Maryland, and Michigan to under 10 percent in Arkansas, New Mexico, Oklahoma, and Tennessee.

Table 12: **Instructional Practices in Mathematics, Grade 4, 1992 NAEP**

STATE	Small Groups at Least Weekly % of Students[a]	Math Projects/Reports at Least Weekly % of Students[b]	Math Manipulatives at Least Weekly % of Students[c]	Use Calculators at Least Weekly % of Students[d]
Alabama	60	3	40	22
Arizona	62	4	38	15
Arkansas	38	0	21	8
California	72	6	57	34
Colorado	73	3	56	31
Connecticut	66	3	62	29
Delaware	55	0	28	24
Dist. of Columbia	85	9	68	59
Florida	70	3	51	21
Georgia	68	1	50	14
Hawaii	54	4	40	35
Idaho	65	2	39	28
Indiana	50	1	27	12
Iowa	60	1	41	18
Kentucky	74	5	51	47
Louisiana	63	4	44	18
Maine	71	0	53	23
Maryland	78	6	62	39
Massachusetts	61	2	48	18
Michigan	64	2	51	38
Minnesota	61	4	42	28
Mississippi	57	2	38	16
Missouri	53.	2	33	14
Nebraska	63	1	45	22
New Hampshire	67	3	53	25
New Jersey	63	2	42	26
New Mexico	60	3	38	9
New York	58	3	46	14
North Carolina	63	3	43	21
North Dakota	45	2	19	14
Ohio	58	1	38	19
Oklahoma	49	2	23	8
Pennsylvania	59	2	33	18
Rhode Island	55	1	35	18
South Carolina	66	1	49	15
Tennessee	56	3	28	7
Texas	70	3	55	24
Utah	65	3	41	21
Virginia	65	2	42	14
West Virginia	57	1	32	24
Wisconsin	65	3	45	34
Wyoming	69	3	42	24
NATION	65	1	46	18

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[a] Teachers' Reports on the Frequency with Which Students Work in Small Groups in Mathematics Class, grade 4 (p. 486)

[b] Teachers' Reports on the Frequency of Projects in Mathematics Class, grade 4 (p. 492)

[c] Teachers' Reports on the Frequency with Which Students Do Work with Objects Like Rulers, Counting Blocks, or Geometric Shapes in Mathematics Class, grade 4 (p. 499)

[d] Students' Reports on the Frequency of Use of Calculators in Mathematics Class, grade 4 (p. 554).

Source: NCES, Data Compendium for the NAEP 1992 Mathematics Assessment.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Elementary Science Instructional Practices

A national sample of elementary, middle, and high school science and mathematics teachers were surveyed in fall 1993 about their instructional practices, preparation, classroom resources, and school conditions (Weiss, 1994). The survey results are an excellent resource on a broad range of national indicators.

Based on teacher reports of time, the average time per week spent on different class activities and methods of instruction, we can summarize the predominant instructional practices in **elementary science** (grades 1–4) as the following:

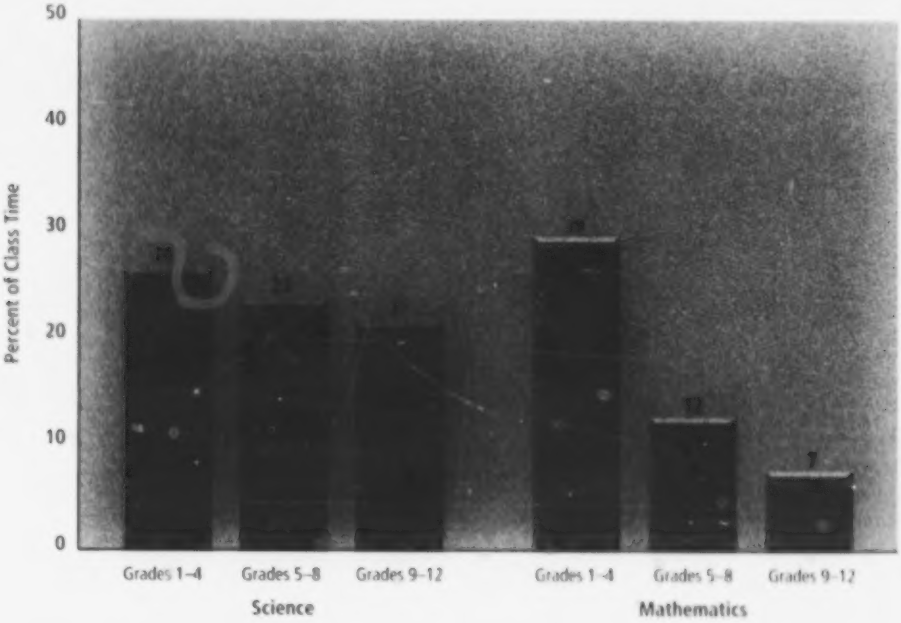
Practice	% of Time
Lecture or whole class discussion	36
Hands on activities or laboratory work	26
Individuals reading texts, doing worksheets, etc	21
Small group work, (non-laboratory)	10
Daily routines, interruptions, and non-instructional activities)	8

By contrast, the percent of time spent on instructional activities reported by high school science teachers was: 42 percent of time on lecture or whole-class discussion and only 21 percent on hands-on activities or laboratory work.

With regard to some specific science activities, 28 percent of elementary science teachers (grades 1–4) say students are never assigned a science project that takes more than a week, as compared to 22 percent of teachers in grades 5–8 and 43 percent of high school teachers.

Computers are never used by students in 38 percent of elementary science classes, 44 percent of grade 5–8 classes, and 54 percent of high school classes. (Weiss, 1994). Students never take field trips in 23 percent of elementary classes (thus, 77 percent of classes do take one or more field trips), as compared to 35 percent of grade 5–8 classes and 62 percent of high school science classes which take no field trips.

Figure 11: **Percentage of Science and Mathematics Class Time Devoted to Hands-On or Manipulative Activities, by Grade Range**



Weiss (1994). A Profile of Science and Mathematics Education in the United States.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Predictors of School Effectiveness in Mathematics at Grade 8

Researchers conducted a multivariate analysis of the 1992 NAEP mathematics assessment results to identify the factors that differentiated schools that were most effective versus least effective in raising students' mathematics proficiency (Mullis, Jenkins, and Johnson, 1994). Hierarchical linear model (HLM) analysis was used to select schools that had higher, or lower, student mathematics performance on NAEP than would be expected according to the socioeconomic and home background of students in the school. Then, the schools' average mathematics scores were analyzed using multiple regression to determine the relationship of the scores to instructional practices, course-taking patterns, and other school characteristics. The analysis identified factors in schools that are related to higher mathematics performance while accounting for differences in the background of the students.

Several of the findings from the analysis of effective schools in grade 8 mathematics are used as state indicators of mathematics education. The analysis of NAEP data was completed by researchers at Educational Testing Service with a national sample of schools and students. (HLM analysis with states as a level of analysis could not be completed due to the large size of the database.) For this report, we decided to include state-by-state statistics for those factors that were identified in the analysis of a national sample of schools. These state-by-state statistics may be useful as indicators to state policymakers and educators; they are not intended to explain differences in state averages on NAEP proficiency.

Table 13 shows state-by-state percentages on four predictors of school effectiveness with grade 8 mathematics :

- ***Frequently do math problems.*** Schools that had more students doing math problems from textbooks almost every day had higher NAEP proficiency than schools where students did problems less often.

This factor is consistent with the NCTM *Standards* (1989) in that it measures time on task, or student effort, and it may differentiate those schools where students are offered more challenging problem situations for using mathematics. State averages show fairly high percentages of students doing problems almost every day across the states, with some differences. Several states are over 90 percent (Idaho, Georgia, Minnesota, Oklahoma, Utah, and West Virginia), while others are below 77 percent (California, Colorado, Connecticut, District of Columbia, Maryland, New York).

- ***Moderate math testing.*** Schools in which students have math testing once or twice a month (i.e., less than weekly) had higher NAEP scores that those schools using weekly or daily tests or schools that hardly ever test.

Several states had over 50 percent of students in classes with moderate testing (Iowa, Minnesota, Missouri, Nebraska, Utah, Wisconsin). Other states had over 75 percent of students with weekly or daily testing (Alabama, Louisiana, Mississippi, South Carolina, Tennessee).

- ***Use calculators more frequently.*** Eight states have over 70 percent of grade 8 students using calculators at least weekly—Colorado, Maine, Minnesota, Missouri, North Dakota, Wisconsin, Wyoming.

NAEP results show that schools vary widely in how often calculators are used in mathematics class, and multivariate analyses show that the proportion of students using calculators at least weekly is an attribute of more effective schools in mathematics. Several states have less than 40 percent of students using calculators weekly, including Louisiana, Massachusetts, Mississippi, New York, Oklahoma.

- ***More students taking algebra.*** Nationally, 19 percent of students take algebra 1 and 28 percent take prealgebra in grade 8. Seven states had over 23 percent taking algebra 1 in grade 8—Delaware, District of Columbia, Florida, Maryland, Massachusetts, Minnesota, Utah. Four states were below 13 percent—Hawaii, Louisiana, North Dakota, Tennessee.

Schools with more students taking an algebra course in grade 8, and planning to take geometry in grade 9, had higher mathematics proficiency than schools with fewer students at this level.

Table 13: Predictors of School Effectiveness in Mathematics, Grade 8, 1992

STATE	Math Problems Almost Every Day % of Students[1]	Math Tests 1–2 Times per Month % of Students[2]	Use Calculators at Least Weekly % of Students[3]	Taking Algebra 1 in Grade 8 % of Students[4]	Taking Pre-Algebra in Grade 8 % of Students[4]
Alabama	88	16	49	15	18
Arizona	84	39	49	20	31
Arkansas	87	26	42	15	19
California	76	46	56	21	21
Colorado	76	47	70	21	36
Connecticut	78	45	53	20	31
Delaware	75	36	53	23	34
Dist. of Columbia	59	28	56	35	19
Florida	87	26	46	23	25
Georgia	91	29	47	18	31
Hawaii	78	40	46	12	27
Idaho	93	45	69	18	41
Indiana	90	44	41	16	15
Iowa	90	53	67	14	24
Kentucky	84	46	66	16	22
Louisiana	88	8	39	12	61
Maine	80	49	73	18	28
Maryland	76	38	49	32	31
Massachusetts	82	32	35	26	33
Michigan	85	41	68	19	23
Minnesota	93	50	75	23	33
Mississippi	87	13	31	13	19
Missouri	86	51	75	13	26
Nebraska	90	54	69	17	25
New Hampshire	79	39	61	18	35
New Jersey	82	38	46	19	23
New Mexico	83	35	46	13	25
New York	71	35	29	13	9
North Carolina	88	28	44	22	30
North Dakota	90	39	72	12	30
Ohio	83	37	52	13	24
Oklahoma	92	42	36	16	36
Pennsylvania	85	40	42	27	27
Rhode Island	82	31	47	21	31
South Carolina	87	21	46	17	17
Tennessee	84	25	42	11	14
Texas	80	30	62	17	18
Utah	91	54	67	32	38
Virginia	87	29	43	19	41
West Virginia	92	41	43	21	27
Wisconsin	85	51	71	14	20
Wyoming	83	46	71	18	33
NATION	84	38	53	19	28

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[1] Students' Reports on the Frequency with Which They Do Mathematics Problems from Textbooks in Mathematics Class, Grade 8 (p. 475)

[2] Students' Reports on How Often They Take Mathematics Tests, Grade 8 (p. 518)

[3] Students' Reports on the Frequency of Use of Calculators in Mathematics Class, Grade 8 (p. 558)

[4] Current Mathematics Course, Grade 8 (p. 407)

Source: NCES, Data Compendium for the NAEP 1992 Mathematics Assessment of the Nation and the States

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Curriculum Emphases in Grade 8 Mathematics

CCSSO staff and John Dossey (mathematics, Illinois State University) conducted an analysis of results from the NAEP mathematics teacher questionnaire to determine the relationship of average NAEP mathematics proficiency to teacher-reported practices, mathematics preparation, and curriculum emphases (CCSSO, 1993a). Two of the key findings on the areas of mathematics content teachers emphasize are shown in Figure 12.

One finding from our analysis was that the percentage of students in classes with heavy teacher emphasis on *numbers and operations* is highly correlated with heavy emphasis on the area of *measurement* ($r = .93$). We also found a high correlation between teachers' heavy emphasis on *algebra/functions* and emphasis on *geometry* ($r = .81$).

States that have more students in classes with heavy emphases on both numbers/operations and measurement may be offering rather traditional programs of study, while those with more students receiving heavy emphasis on geometry and algebra/functions at the grade 8 level may be moving toward a richer, more ambitious program of study, similar to that called for by the NCTM *Standards*.

In Figure 12, states are ordered by the percentage of students with teachers that placed heavy emphasis on geometry and algebra/functions.

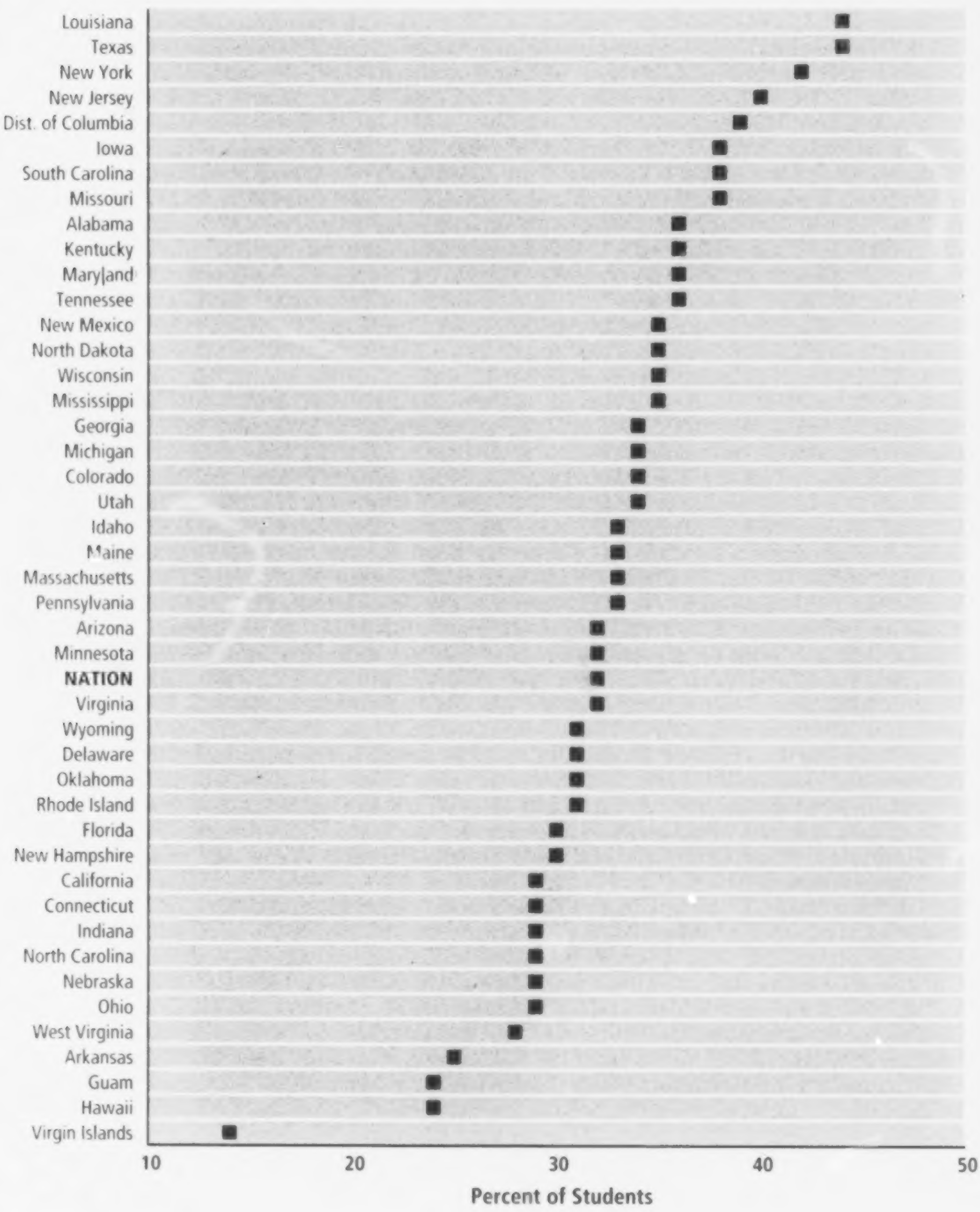
- States with higher percentages of students in classes with teachers emphasizing algebra/functions and geometry tended to have higher average NAEP mathematics proficiency.

States with over 35 percent of students in classes with these emphases include New Jersey, Iowa, North Dakota, and Wisconsin—all with high average student proficiency. Some states with lower average proficiency also were high on this measure (e.g., Louisiana, Texas, DC, South Carolina) indicating a positive correlation, but not a perfect predictor for every state (CCSSO, 1993).

- The states with higher percentages of teachers emphasizing numbers, operations, and measurement tended to have lower average NAEP geometry proficiency at grade 8.

See Appendix C for states ordered by the percentage of students in classes with heavy emphasis on numbers/operations and measurement. States with over 50 percent of students in classes with these emphases include Mississippi, Guam, South Carolina, Alabama, Georgia, and Tennessee, which are all among the states with the lowest average mathematics proficiency.

Figure 12: **Curriculum Emphasis on Algebra/Functions and Geometry, Grade 8, 1992**



Note: Curriculum emphasis = teachers reporting that they give heavy emphasis to topics, computed by students in these classes.

Source: NCES, Data Compendium for the NAEP 1992 Mathematics Assessment of the Nation and the States.

Chapter Three
Indicators of Teacher Preparation and Supply

- **Teachers with a Major in Assigned Field**
- **Teacher Coursework in Areas of Content Standards**
- **Teachers Certified in Assigned Field**
- **Teachers Race/Ethnicity, Gender, and Age**

National professional standards in mathematics and science (NCTM, 1989, 1991; NRC, draft, 1994) call for a change in teaching to emphasize active learning by students, deep understanding of concepts, and developing skills in problem-solving and reasoning. The standards for teaching in mathematics and science deemphasize teacher lectures, memorizing facts and terminology, and curriculum aimed at briefly covering many topics. One implication of challenging content standards for all students is that teachers need in-depth knowledge and understanding of the discipline and skills in a variety of classroom practices that actively engage students in mathematics and science.

Indicators for mathematics and science in teacher preparation and teacher supply should be able to inform educators, policymakers, and the public about conditions and trends regarding **key policy issues**, such as:

- *What proportion of current teachers have knowledge and teaching skills in their field at the level outlined by professional standards?*
- *Do we have a sufficient number of teachers currently, and are new teachers coming into math and science that would allow us to improve the quality of teaching?*
- *What improvements in the knowledge and skills of teachers are needed? What efforts are currently being made to improve teachers' knowledge and skills?*

The currently available state-by-state indicators regarding teachers and teaching provide some answers to these issues. We can report statistics by state on the level of preparation of teachers in their assigned teaching field based on data from Schools and Staffing Survey and NAEP. We can report state statistics on the current supply of teachers with state certification by teaching field and the number of teachers by race, gender, and age, based on state data. State indicators of the amount and quality of professional development in science and mathematics can be developed from SASS 1994 data (although the data were not ready in time for this report).

We do not currently have direct measures of teachers' knowledge and skills, for comparison to professional standards. The previous section of the report provided some indicators of teaching practices by state.

Teachers with a Major in Assigned Field

A state indicator of the preparation of teachers in their assigned teaching field of science or mathematics is the percentage of teachers that hold a major in that field in an undergraduate or graduate degree. A major in the teaching field is a relatively consistent measure of the extent of the knowledge of the subject by teachers. Research has shown a positive relationship between amount of coursework preparation of teachers in science and mathematics and student learning in those fields (Shavelson et al., 1989). A recent analysis of data from the Longitudinal Study of American Youth, which follows the academic progress of a national sample of students, shows that each additional mathematics course taken by mathematics teachers above the average for teachers translates into 2 to 4 percent higher student achievement (Monk, 1993).

Mathematics Teachers

The 1991 Schools and Staffing Survey (SASS) provides the most recent state-by-state statistics on college majors of teachers. The survey is conducted with a representative sample of teachers in each state.[2] Figure 13 shows a bar graph with states rank-ordered according to the percentage of secondary (grade 7–12) teachers with their main assignment in math that majored in math or math education. States with 75 percent of their secondary mathematics teachers with majors in math include Minnesota, Alabama, Nebraska, Wisconsin, and North Dakota. However, nine states had less than half of mathematics teach-

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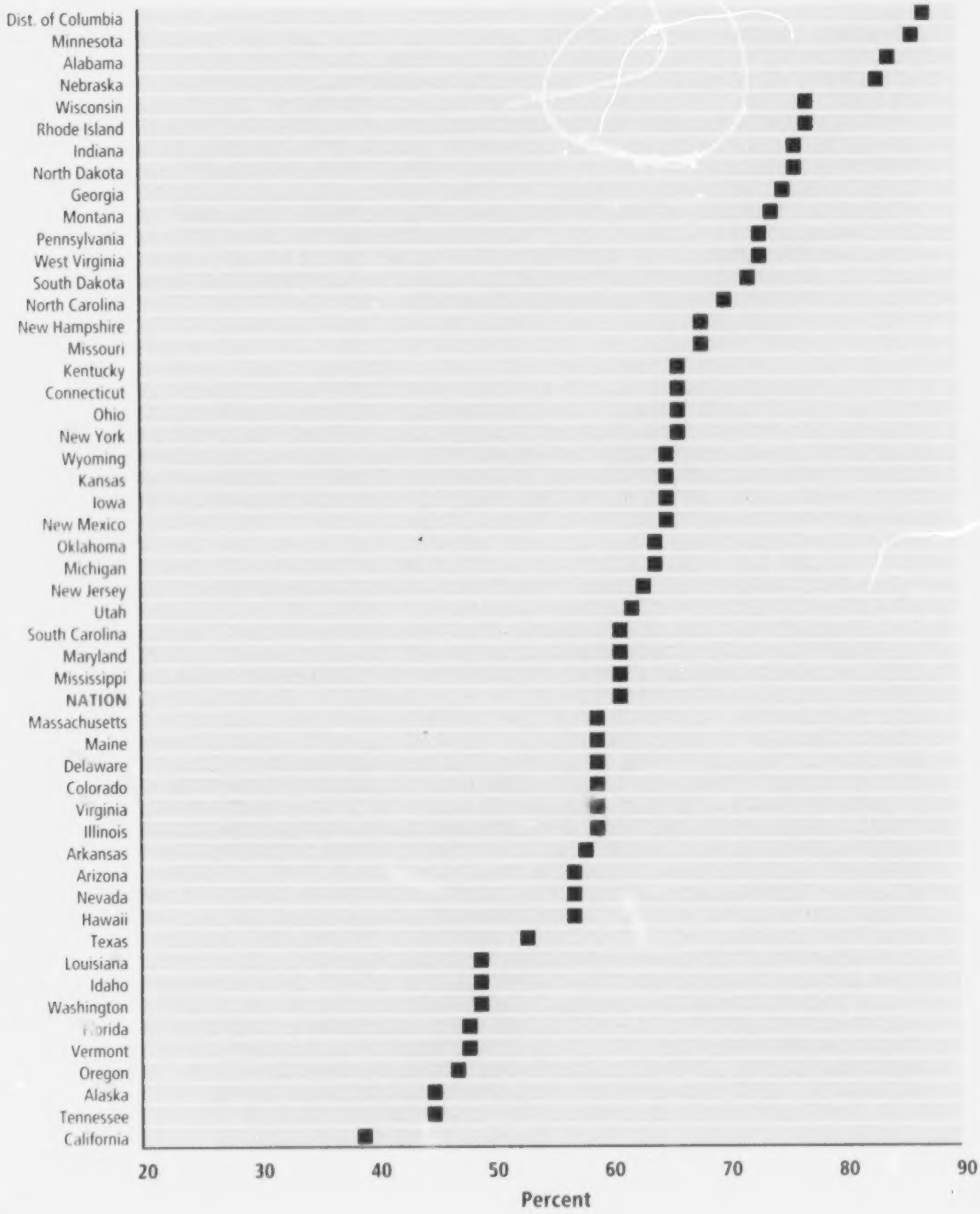
[2] The number of mathematics and science teachers by field and main vs. other (second/third) assignment for grades 7-8 and 9-12 are reported by state in Appendix D.

Figure 13: **Percentage of Mathematics Teachers with Major in Mathematics, Grades 7–12, 1991**



Note: Percent with major = teachers with main assignment in math and a major in math or math education.

Source: NCES, Schools and Staffing Survey, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

ers with math majors, including California, Florida, Tennessee, Alaska, Oregon, and Washington. In the latter group of states, more than five out of every 10 teachers do not have a strong background in mathematics, which means that 50 percent of students are taught by a teacher that majored in some other field than the one they are teaching.

Nationally, 60 percent of secondary mathematics teachers (grades 7–12) majored in mathematics or mathematics education, as of 1991. There was a slight decrease from 62 percent in 1988, although the difference is not statistically significant. Further analyses of teacher majors by field show that 68 percent of high school mathematics teachers (grades 9–12, main assignment) have a mathematics major (NCES, 1994d).

Percentage of U.S. Secondary Mathematics Teachers with Major in Field

	Math – Main Assignment **% with Major**	All Math Teachers **(1 or more period) % with Major or Minor**
1988	62	60
1991	60	59[1]

Source: NCES, Schools and Staffing Survey

- In total, only 59 percent of all U.S. mathematics teachers have strong preparation in mathematics (major or minor), indicating that 61,000 teachers of the total of 154,000 mathematics teachers in our secondary schools have poor preparation in mathematics.

In Table 14, we can compare the preparation of teachers with *main assignment* in mathematics with the preparation of *all* teachers of mathematics, which includes any teacher assigned to mathematics one or more periods per day. The percentage of all teachers of secondary math that have a major or minor in mathematics or math education varies from under 45 percent in Alaska, Delaware, and Washington to over 80 percent in Pennsylvania and District of Columbia. In a number of states the percentage for all teachers with a major or minor is lower than the percentage for main assignment with major (e.g., see Alabama, Alaska, Colorado, Delaware, Hawaii, Maryland, Michigan, etc.). This may mean part-time math teachers have relatively poor preparation in these states.

Science Teachers

The state percentages for science teachers with a major in a science field are show in Figure 14. Several states have over 80 percent of secondary science teachers, with main assignment in science, that majored in a science field or science education, including: New Hampshire, Alaska, Minnesota, and Oregon. However, nine states have less than six out of 10 science teachers with a science major, including: Nevada, Louisiana, Arkansas, Kansas, New Mexico, and Florida.

The 1991 national average was 69 percent of secondary science teachers (7–12) with a major in a science field or science education. The proportion with a major is virtually the same as the proportion for 1988. Further analysis of these data showed that 78 percent of high school science (9–12) teachers majored in a science field or science education, as of 1991.

Percentage of U.S. Secondary Mathematics Teachers with Major in Field

	Science – Main Assignment **% with Major**	All Science Teachers **(1 or more period) % with Major or Minor**
1988	73	70
1991	69	75[2]

Source: NCES, Schools and Staffing Survey

We can compare the preparation of teachers with *main assignment* in science with the preparation of *all* teachers of science, which includes any teacher assigned to a science subject (earth science, biology, chemistry, etc.) one or more periods per day. In Table 14, we can see that a higher percentage of all science teachers have a major or minor in their field than do all mathematics teachers. The percentages for science teachers do include teachers assigned between different fields of science, e.g., a teacher with a major or minor in biology who is assigned to teach one period of chemistry.

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[1] Standard error = 1.3 for Math, main, and 1.0 for all Math

[2] Standard error = 1.7 for Science, main, and 1.4 for all Science

Table 14: Mathematics and Science Teachers with Major in Assigned Field, Grades 7–12, 1991

	Main Assignment:		All Teachers:	
	Math	Science	Math	Science
STATE	**% with Major in Math**	**% with Major in Science**	**% with Major or Minor**	**% with Major or Minor**
Alabama	84	71	68	74
Alaska	45	86	32	79
Arizona	57	70	54	80
Arkansas	58	49	76	84
California	39	65	47	71
Colorado	59	82	53	82
Connecticut	66	80	62	91
Delaware	59	67	42	69
Dist. of Columbia	87	100	100	100
Florida	48	54	54	65
Georgia	75	65	59	61
Hawaii	57	70	53	62
Idaho	49	73	59	86
Illinois	59	74	59	77
Indiana	76	77	62	85
Iowa	65	63	55	63
Kansas	65	50	66	59
Kentucky	66	63	64	64
Louisiana	49	46	55	59
Maine	59	72	57	71
Maryland	61	79	49	74
Massachusetts	59	74	55	86
Michigan	64	78	48	71
Minnesota	86	86	77	93
Mississippi	61	61	57	75
Missouri	68	80	74	74
Montana	74	74	73	77
Nebraska	83	85	61	86
Nevada	57	34	58	68
New Hampshire	68	87	75	89
New Jersey	63	77	59	75
New Mexico	65	51	56	66
New York	66	78	61	83
North Carolina	70	80	58	84
North Dakota	76	77	63	89
Pennsylvania	73	81	81	86
Tennessee	45	54	54	63
Virginia	59	76	59	79
West Virginia	73	65	74	80
Wisconsin	77	70	66	72
Wyoming	65	78	59	82
NATION	**61**	**69**	**59**	**75**

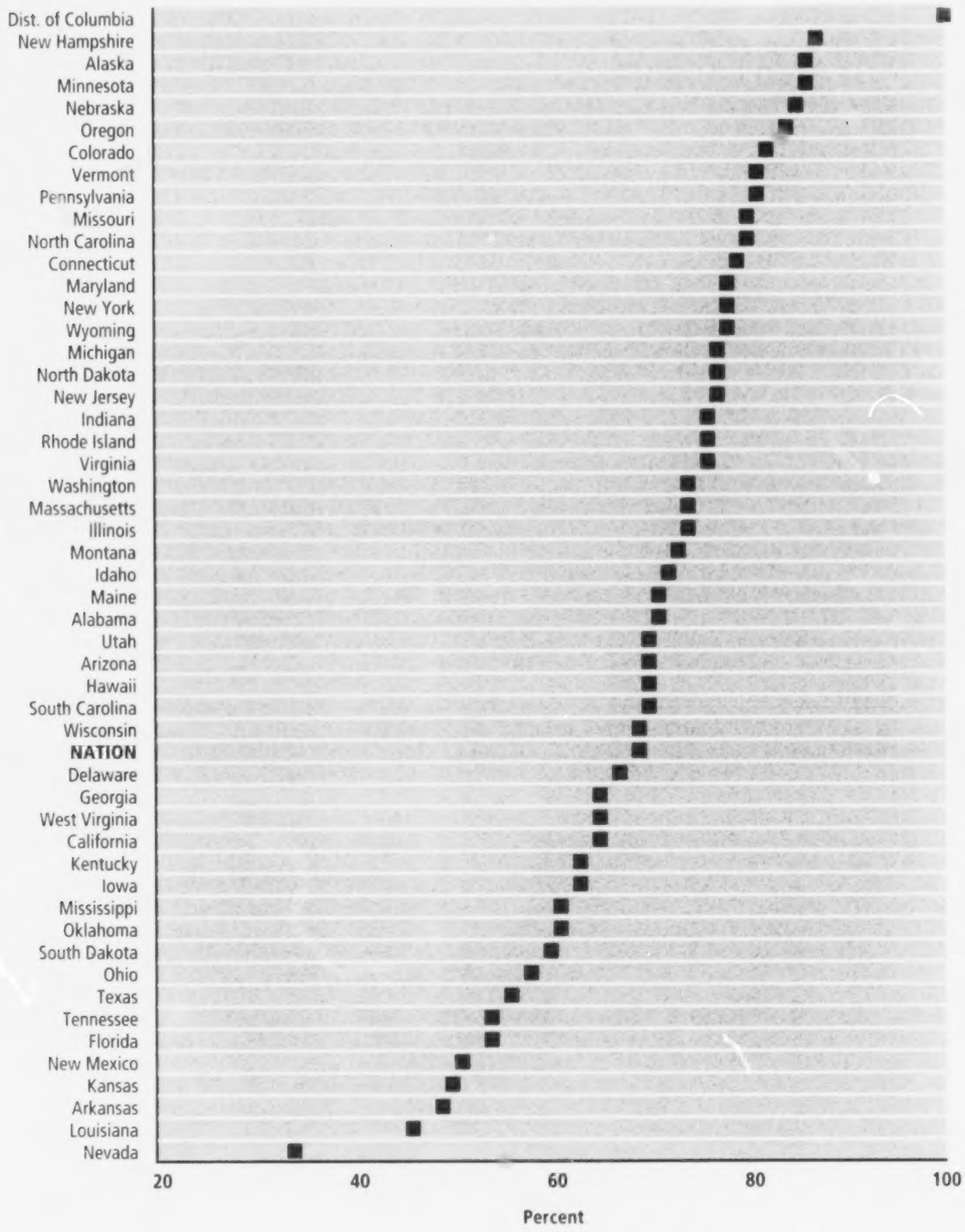
Notes: Percent with major = Percent of assigned teachers with an undergraduate or graduate degree with a major in math (science field) or math education (science education).

All teachers = Teachers assigned 1 or more periods to subject. (See Appendix F for standard errors.)

Source: NCES, Schools and Staffing Survey, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 14: **Percentage of Science Teachers with Major in Science, Grades 7–12, 1991**



Note: Percent with major = teachers with main assignment in science and a major in a science discipline or science education.

Source: NCES, Schools and Staffing Survey, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

- In total, three-fourths of all U.S. secondary science teachers have strong academic preparation in science (major or minor), which means that 37,000 teachers of the total secondary science teachers have poor preparation in science.

The national statistics on teachers with a major in their assigned field in mathematics and science indicate there was no significant improvement from 1988 to 1991 toward a key objective of National Education Goal 5 to "increase by 50 percent the number of teachers with a substantive background in science and math" (NEGP, 1994). Data will continue to be tracked through the 1990s for this indicator to determine improvement in teacher preparation in mathematics and science. Data from the 1994 SASS will be available by state in fall 1995.

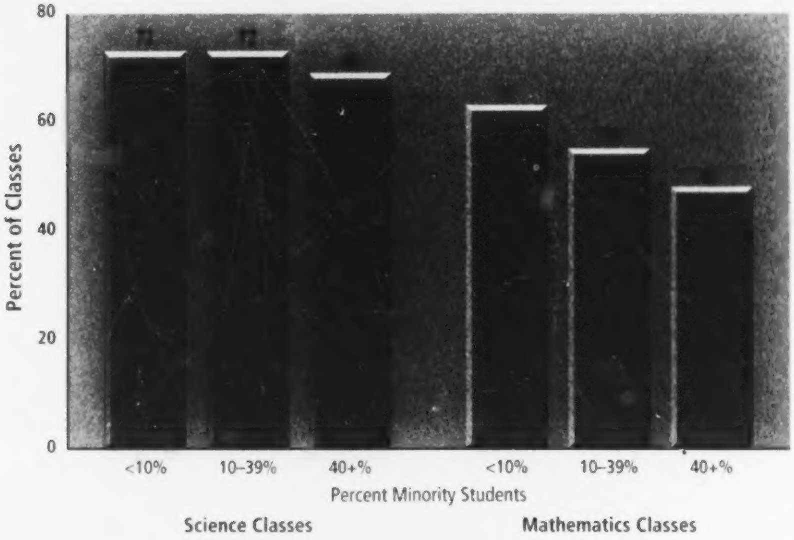
Preparation of Teachers by Student Race/Ethnicity

In reporting indicators of the preparation of teachers in mathematics and science, we need to consider whether variation in teacher preparation is related to the family and community background of students. That is, do certain groups of students get better or less well prepared teachers?

Results from Weiss' 1993 survey of a nationally representative sample of elementary and secondary teachers, reported in Figure 15 show that only 47 percent of mathematics teachers in classes with high minority enrollments have a degree in math or math education. In mathematics classes with less than 10 percent minority students, over 60 percent of teachers majored in mathematics. Thus, race/ethnicity of students does appear to make a difference in quality of mathematics teachers they are assigned. In science classes, the preparation of teachers differs less according to student race/ethnic composition—in low-minority classes 72 percent of science teachers have science majors, whereas 68 percent of teachers have science majors in high-minority classes (Weiss, 1994).

As a national average, students who are taught in high-minority mathematics classes have less chance of being taught by a teacher who is well prepared in mathematics. In science, classes with various proportions of minority students are almost equally likely to have teachers with majors in science. This indicator is not available state by state. Many states could provide this kind of indicator of teacher preparation by student background for the districts or schools in a state. This information might be more useful to local educators than simply the state average for teachers with a major in their field.

Figure 15: **Percentage of Grades 7–12 Science and Mathematics Classes Taught by Teachers with Major in Field, by Percentage of Minority Students in Class**



Weiss (1994)

Teacher Coursework in Areas of Content Standards

The preparation of teachers in mathematics and science can also be indicated by a comparison of undergraduate and graduate coursework of teachers, with the recommended content standards for elementary and secondary education. This indicator can provide a more current picture of the preparation of teachers in their field, since the college major could have been completed from one to 40 years previously.

Professional standards for teaching mathematics and science have been produced by NCTM (1991) and NRC (1994, draft), respectively. These standards recommend that teachers have coursework preparation in the content areas of curriculum standards for student learning. The 1992 NAEP Mathematics teacher questionnaire asks mathematics teachers to report the number of college courses they have completed in six content areas of mathematics recommended by NCTM—number systems, measurement, geometry, statistics, abstract algebra, calculus.

- Nationally, 48 percent of grade 8 students had mathematics teachers who completed coursework in five to six of the recommended content areas, 27 percent completed courses in three to four areas, and 26 percent completed courses in zero to two areas. The NAEP results for 1992 demonstrated that the amount of mathematics coursework completed by teachers has a positive relationship to student mathematics proficiency (Mullis et al., 1993).

Table 15 shows states listed by the percentage of students with grade 8 teachers who completed coursework in five to six NCTM mathematics content areas. Also shown is the percentage of students with teachers in the state that completed work in zero to two areas. There are differences in level of coursework in mathematics according to student proficiency by state.

- Among the 10 states with the highest mathematics proficiency at grade 8 (Maine, Iowa, New Hampshire, Wisconsin, North Dakota, Minnesota, New Jersey, Connecticut, Massachusetts, Nebraska), seven states had over 55 percent of students with teachers prepared in five to six math areas, and less than 20 percent have teachers with coursework in zero to two areas.

Conversely, seven of the 10 states with the lowest average mathematics proficiency had less than 45 percent of students being taught by teachers with coursework in five to six content areas.

Table 15: **Teachers' Coursework in Content Areas of Mathematics Standards, Grade 8, 1992**

STATE	Math Courses in Five to Six Areas (% of Students)	Math Courses in Zero to Two Areas (% of Students)
Indiana	65	10
Minnesota	64	11
New York	58	16
Pennsylvania	58	14
Dist. of Columbia	57	21
North Dakota	57	16
Rhode Island	57	13
Massachusetts	56	21
New Hampshire	56	17
Wyoming	56	11
Delaware	54	18
Utah	54	20
Nebraska	53	19
Connecticut	52	16
Iowa	52	18
Alabama	50	17
Oklahoma	50	24
West Virginia	50	16
Missouri	49	15
NATION	48	26
New Mexico	47	18
Virginia	47	16
Maine	46	28
Maryland	46	24
South Carolina	46	25
Arkansas	45	16
Wisconsin	45	28
Florida	43	24
Georgia	43	29
Hawaii	43	31
Mississippi	43	27
Texas	43	21
Colorado	42	24
Idaho	41	22
Kentucky	41	27
Michigan	41	33
New Jersey	41	35
North Carolina	41	31
Virgin Islands	40	44
California	38	32
Louisiana	38	30
Ohio	37	29
Tennessee	35	37
Arizona	31	34
Guam	31	25

Teachers' Reports on Mathematics College Courses Taken Summarized Across Six Mathematics Areas, Grade 8 (p 631)

NCES, Data Compendium for the NAEP 1992 Mathematics Assessment of the Nation and the States.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Teachers Certified in Assigned Field

State certification in the assigned teaching field indicates that teachers have a basic level of preparation in the subject they are teaching. Using teacher personnel files and teacher assignment data, states reported the number of teachers of high school mathematics and science who are certified. States reported on certification status by specific science fields, for example, biology, and by percent of time assigned to the field (or, by main assignment vs. second or third assignment). The proportion of teachers who are certified in the subjects they are teaching is an important policy indicator for state and local educators because state certification is often used as a basic measure of teacher qualification and as an indicator of teacher supply and shortage. It is not, however, an adequate measure of quality of teacher preparation, particularly in cross-state comparisons, because of the differing state standards for certification.

High School Teachers by Certification

Table 16 summarizes the percentage of high school teachers by state that are assigned to mathematics, biology, chemistry, physics, and earth science and certified to teach in these fields. Certification in a field means the teacher holds a state's regular, standard, advanced, or probationary certificate in the assigned field subject. In science, the teacher holds a specific-field certification (e.g., biology) or broad-field certification (multiple fields of science).

Highlights of the indicator of teacher certification by state at the high school level are as follows:

- ***Nationally:*** 90 percent of all high school mathematics teachers are state certified in mathematics; 90 percent of biology teachers are certified in biology or broad-field science, 92 percent of chemistry teachers are certified in chemistry or broad-field science, 86 percent of physics teachers are certified and 81 percent of earth science teachers are certified.
- ***Mathematics:*** 16 states (of 36 reporting certification data) have over 95 percent of all high school math teachers certified in mathematics, while three states have less than 80 percent certified mathematics teachers (Hawaii, Texas, Colorado).
- ***Biology:*** 21 states (of 36) have over 95 percent certified teachers, while two states have less than 80 percent of biology teachers that are certified in the subject (Mississippi, Texas).
- ***Chemistry:*** 19 states (of 36) have over 95 percent certified teachers, while two states have less than 80 percent of chemistry teachers that are certified in the subject (Idaho, Nebraska).
- ***Physics:*** only eight states (of 36) have over 95 percent certified teachers, while six states have less than 80 percent of physics teachers that are certified in the subject (Louisiana, Mississippi, Idaho, Nebraska, Oklahoma, Texas).

Data on teacher certification trends from 1990 to 1994 indicate that overall the picture has changed very little. In 1990, 91 percent of all math teachers were certified, compared to 90 percent in 1994; 92 percent of biology teachers were certified in 1990, compared to 90 percent in 1994; and 92 percent of chemistry teachers were certified in 1990, which is the same as in 1994.

See Appendix D for state requirements for teacher certification. Appendix E shows statistics on teacher certification in math and science for urban districts as compared to state.

Middle-Level Teachers by Certification

States also reported data on the certification status of middle-level science and mathematics teachers (grades 7–8), and the results are shown in Table 17. Many states find these data are important indicators for two reasons: (1) the middle grades are often where students either develop strong interests and aspirations in science and mathematics, or their interests become curtailed; and (2) the middle grades are often where states, districts, and schools find it difficult to fill positions with well-qualified teachers in science and mathematics. We asked that states differentiate between teachers assigned to grades 7–8 math and science that are certified in elementary education and those certified in math or science.

- The percentage of grade 7–8 math teachers certified in mathematics varies from 23 percent in Texas and 30 percent in Kentucky to 96 percent in Minnesota and 100 percent in New Jersey and District of Columbia. Twenty states (of 31 reporting) have over half the middle level math teachers at this level certified in math. If both mathematics and elementary

Table 16: Certification of Mathematics and Science Teachers, Grades 9–12, 1994

STATE	Mathematics % Certified	Biology % Certified	Chemistry % Certified	Physics % Certified	Earth Science % Certified
Alabama	98	99	94	88	100
Arkansas	–	97	95	86	81
California	82	86	85	86	86
Colorado	77	93	–	–	–
Connecticut	98	97	95	89	80
Delaware	91	92	95	90	100
Dist. of Columbia	100	100	100	100	–
Hawaii	74	81	86	86	82
Idaho	95	98	78	76	95
Illinois	96	95	95	96	95
Indiana	96	96	96	85	74
Kentucky	98	97	99	83	48
Louisiana	92	86	85	69	60
Massachusetts	90	93	97	97	88
Minnesota	97	96	86	88	76
Mississippi	91	79	68	53	56
Missouri	99	96	96	81	68
Montana	95	99	98	97	94
Nebraska	88	91	76	71	66
Nevada	96	98	100	94	84
New Jersey	100	100	100	100	100
New Mexico	92	92	88	90	81
New York	93	92	92	87	79
North Carolina	88	91	96	89	87
North Dakota	100	100	100	100	100
Ohio	95	89	94	93	78
Oklahoma	94	98	98	80	85
Pennsylvania	90	94	93	93	94
Puerto Rico	90	99	98	94	95
Rhode Island	100	100	100	100	100
South Dakota	96	96	93	89	97
Tennessee	91	95	96	89	34
Texas	74	75	86	79	64
Utah	89	89	83	85	68
Wisconsin	100	100	100	100	100
Wyoming	92	96	94	93	97
NATION	88	90	92	86	81

Data not available. % Certified = Teachers assigned 1 or more period to subject who have state certification in subject. Science % Certified = specific field or broad-field certification. Colorado: Science, all fields; Delaware: Main assignment only; Pennsylvania: grades 7–12.

State Departments of Education, Data on Public Schools, Fall 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

certification are counted, over 90 percent of middle-level math teachers are certified in almost all states.

- In science, the percentage of grade 7–8 science teachers certified in science varies by state from 26 percent to 100 percent. Twenty-four states (of 31 reporting) have over half their grade 7–8 science teachers certified in science.

Teachers with Major/Minor vs. Certification

The percentage of teachers with a major or minor in a field is typically significantly smaller than the percentage certified in the field, if we compare Tables 14, 16, and 17. For example, Illinois has 96 percent of grade 9–12 math teachers certified and 97 percent of grade 7–8 math teachers certified, but only 59 percent of these teachers have a major or minor in mathematics or math education.

The data on certification reported in Tables 16 and 17 do not differentiate teachers with main assignment in the subject vs. those with second or third assignment to the subject. In many states,

Table 17: Certification of Mathematics and Science Teachers, Grades 7–8, 1994

STATE	Mathematics % Certified Math	 % Certified Elementary	Science % Certified Science	 % Certified Elementary
California	45	41	61	25
Colorado	46	26	68	16
Connecticut	49	50	59	41
Delaware	74	22	79	13
Dist. of Columbia	100	0	100	0
Hawaii	38	38	40	33
Idaho	52	46	75	23
Illinois	0	97	0	95
Indiana	87	0	92	5
Kentucky	30	64	26	62
Louisiana	86	0	79	0
Massachusetts	68	27	70	24
Minnesota	96	0	80	0
Mississippi	37	63	52	47
Missouri	88	0	81	0
Montana	50	49	43	55
Nebraska	92	0	75	0
Nevada	56	44	48	52
New Jersey	100	0	100	0
New Mexico	38	56	62	35
New York	92	0	87	0
North Carolina	68	5	68	4
North Dakota	58	42	70	30
Ohio	50	45	38	56
Oklahoma	55	43	67	31
Puerto Rico	84	0	100	0
Rhode Island	100	0	100	0
South Dakota	97	0	92	0
Texas	23	0	55	0
Utah	83	0	73	0
Wyoming	73	27	75	25

Certified math (science) = Teachers assigned 1 or more period to subject who have state certification in secondary math (science) or middle level math (science). Certified Elementary = Certification in Elementary Education, General Secondary/Middle, or subject not assigned.
Texas: % certified elementary was reported under "not certified" (see Appendix D).

State Departments of Education, Data on Public Schools, Fall 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

the certification rate varies substantially for teachers in their main teaching field as compared to teachers assigned to a second or third field. The rate of certification by field is disaggregated by assignment in Appendix D.

Broad-field Science Certification

Two-thirds of the states have a certification for "broad field" secondary science certification that covers teaching in biology, chemistry, physics, and other science subjects. Many of the states also have certification in the specific fields of biology, chemistry, physics, etc. See Appendix D for differences in state certification requirements.

An analysis of state data by CCSSO revealed that almost one-third of all high school science teachers are certified through a broad-field certification. Many schools must hire teachers to teach two or three science subjects, and they tend to hire teachers who have received state certification through a broad-field, or "nonspecialist," method of science certification.

Teachers' Race/Ethnicity, Gender, and Age

The current distributions and trends in the number of science and mathematics teachers by gender and race/ethnicity provide a basis for states and the nation to compare the characteristics of the current teaching force with goals of improving the match between students and teachers in terms of gender and race/ethnic characteristics.

National survey data (Weiss, 1994) and previous CCSSO reports (1991, 1993) show that minority science and mathematics teachers and female science teachers are vastly underrepresented, considering the student population in our schools. Oakes' (1990) analysis of teacher characteristics and student participation and opportunities in science and mathematics demonstrated that the rate of participation of minority and female students in science and mathematics is related to the characteristics of their teachers.

Race/Ethnicity of Science and Mathematics Teachers

In 1990, CCSSO reported state data on the race/ethnicity of high school science and mathematics teachers. With the 1994 data, we can examine state-by-state percentages of white and minority teachers, as compared to their student populations; and we can observe any trends in increase or decrease in the proportion of minority teachers, which are a shortage in almost all states. Not all 50 states have data available on teacher race/ethnicity by subject.

Table 18 ranks the states by the percentage minority students to show comparisons with the percentage minority teachers in several fields. Appendix D gives a breakdown of teacher race/ethnicity by five race/ethnic groups.

States with the highest proportions of minority teachers in science and mathematics (over 15 percent) are in the Southeast states and Hawaii. There is relatively little differences between the subjects in the percentage of teachers that are minorities, although chemistry and physics have slightly fewer minority teachers in most states.

Figure 16 graphically compares the proportion of high school biology teachers in each state who are from racial/ethnic minority groups with the proportion of students (K–12) who are minorities. Of the 20 states with more than 20 percent minority students, only five states have even half as many minority teachers in biology as the percentage minority students (Virginia, Alabama, South Carolina, Mississippi, Hawaii).

Nationally, the percentage minority teachers in four high school fields is as follows (including imputation for missing states):

Minority Teachers in High School Mathematics and Science

Subject	% Minority
Mathematics	14
Biology	13
Chemistry	9
Physics	6

Source: CCSSO and state departments of education, 1994

By comparison, 14 percent of all public school teachers are minority teachers, and 33 percent of students in our public schools are minority students.

Gender of Science and Mathematics Teachers

Figure 17 shows a state-by-state bar graph of the percentage of mathematics teachers that are female, and it shows the change in the percentage female from 1990 to 1994. The distribution of mathematics teachers by gender varies widely by state, from under 30 percent female in Minnesota and Oregon to almost 70 percent female in North Carolina and Alabama.

State data aggregated to the nation indicate 49 percent of high school mathematics teachers were females as of 1994. The gender distribution of teachers by subject for the nation, with imputation for missing states, shows the following totals.

Female Teachers in High School Mathematics and Science

Subject	% Female
Mathematics	49
Biology	42
Chemistry	37
Physics	24

Source: CCSSO and state departments of education, 1994

The trends by state show that over the past four years, more states have increased the percentage of females in math teaching, with the percentage female going up by five percentage points

Table 18: Minority Teachers in Mathematics and Science by Minority Students in State, 1994

STATE	% Minority Students	Math % Minority Teachers	Biology % Minority Teachers	Chemistry % Minority Teachers
Idaho	8	1	1	0
Iowa	8	1	1	1
Utah	8	2	1	1
Kentucky	9	2	3	1
North Dakota	9	0.2	0.4	1
Minnesota	10	1	0.4	1
Nebraska	11	1	1	1
Oregon	11	4	4	–
Montana	12	1	0	0
South Dakota	13	0	0.4	1
Indiana	14	3	4	3
Kansas	14	–	–	–
Ohio	15	4	5	3
Wisconsin	15	1	2	1
Pennsylvania	16	5	3	1
Rhode Island	17	2	4	1
Missouri	18	5	5	3
Washington	18	–	–	–
Massachusetts	21	6	7	4
Michigan	22	–	–	–
Tennessee	22	–	–	–
Connecticut	23	4	6	4
Colorado	25	5	6	–
Nevada	26	6	9	2
Arkansas	27	8	9	6
Oklahoma	28	4	5	4
Delaware	30	7	3	0
New Jersey	32	9	9	6
North Carolina	32	13	15	11
NATION	33	14	13	9
Illinois	35	10	11	8
Alabama	40	15	18	15
Mississippi	48	23	27	25
Texas	48	19	21	13
California	53	18	17	13
New Mexico	58	21	20	15
Hawaii	76	66	64	60

– Data not available

Percent minority teachers = Asian Pacific Islander, Black, Hispanic, and American Indian teachers—grades 9–12

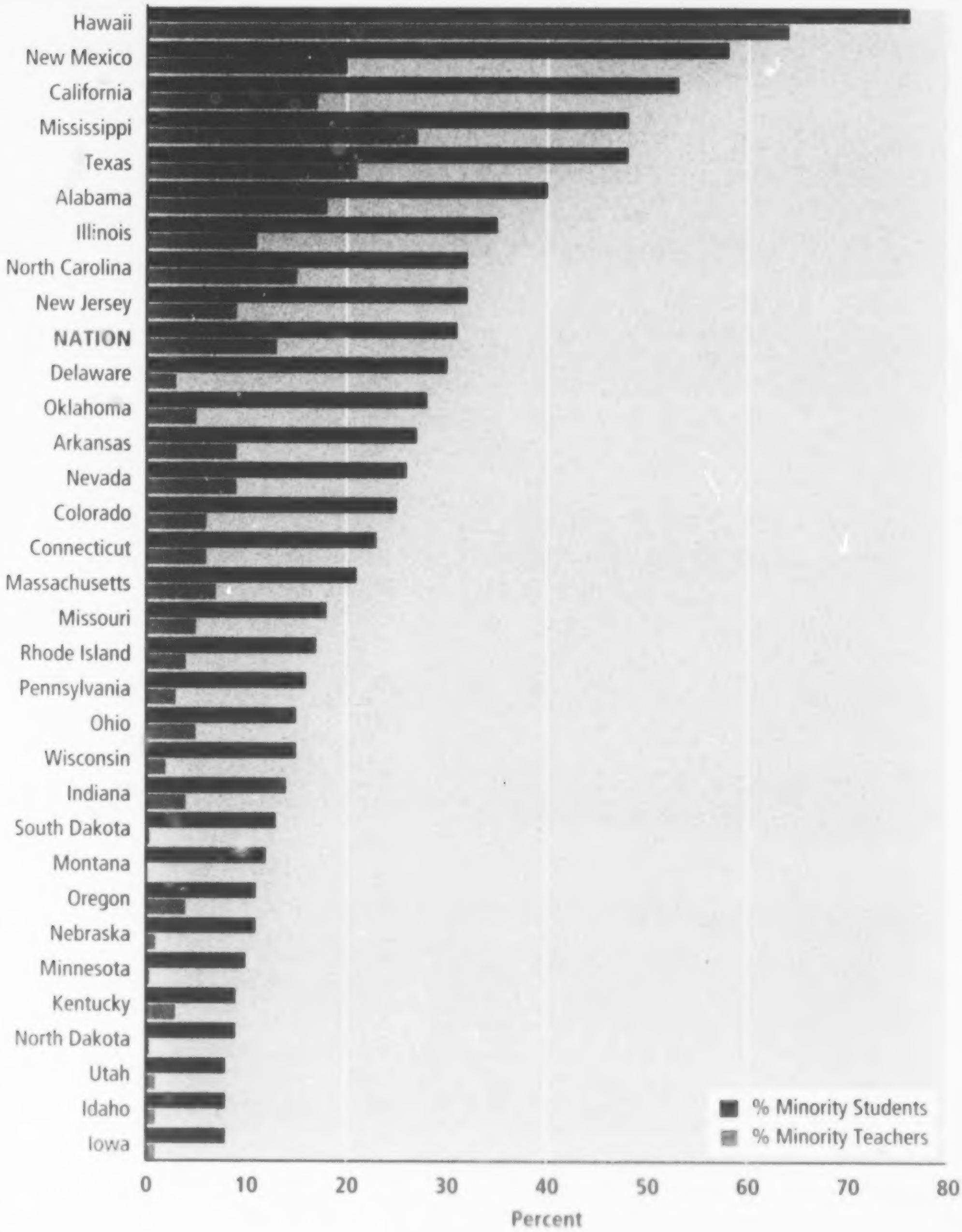
Minority teachers reported under Biology for Colorado = all science

Pennsylvania = grades 7–12

(Teachers 9–12) State Departments of Education, 1993–94; (Students K–12) NCES, Common Core of Data: Fall 1993

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Figure 16: **Minority Biology Teachers as Compared to Minority Students, 1994**



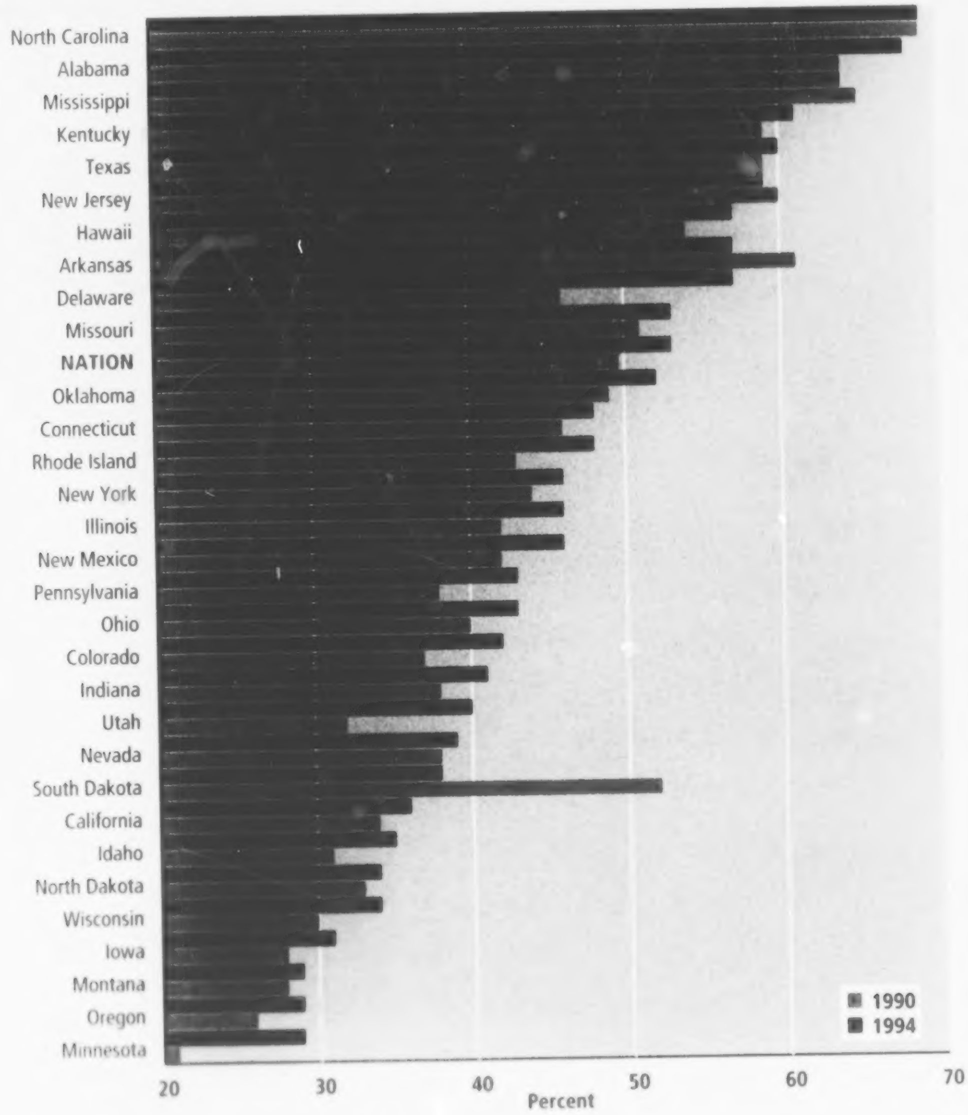
(Teachers 9–12) State Departments of Education, 1993–94; (Students K–12) NCES, Common Core of Data, Fall 1993

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

in several states, e.g., Delaware, Pennsylvania, Utah, Minnesota, while a few states have increased the percentage male (decline in percentage female), e.g., Arkansas, South Dakota, North Carolina.

The gender distribution of mathematics and science teachers by state shows that geographic region is associated with the pattern across states. Eleven of the 32 reporting states have more female than male mathematics teachers, and eight are Southeastern states. Across all fields, Southeastern states have the highest proportion of female high school teachers, and states in the Midwest have the lowest proportion. The map of chemistry teachers in Figure 18 by percentage female per state shows the regional pattern. Data on high school teachers in other fields by state confirm this pattern (see Appendix D).

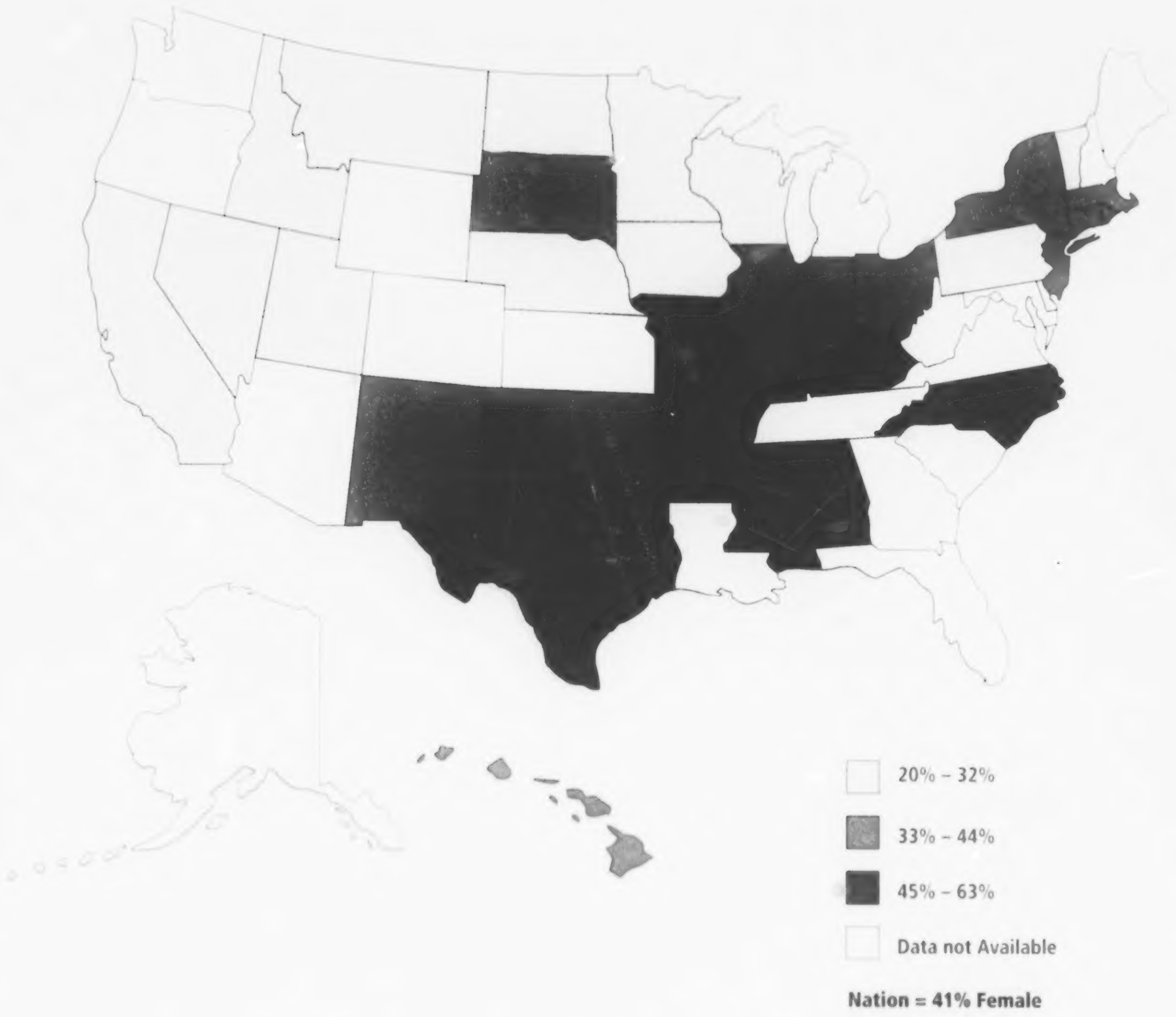
Figure 17: **Gender of Mathematics Teachers (Percent Female), 1990 to 1994**



State Departments of Education: Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 18: **Gender of Chemistry Teachers (Percent Female), 1994**


20% - 32%
33% - 44%
45% - 63%
Data not Available
Nation = 41% Female

State Departments of Education, Data on Public Schools, 1993-94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Age Distribution of Science and Mathematics Teachers

In 1989–90, the states reported data to CCSSO on the age distribution of science and mathematics teachers, and the 1993–94 data on teacher age by field provide an indicator of trends by state. Teacher data from states are based on the universe of current teachers from state education information systems. Statistics on the percentage of science and mathematics teachers in specific age categories provide useful information for estimating possible shortage fields as teachers near retirement age or leave teaching. Also, we can review the flow of new, younger teachers into these teaching fields.

Table 19 shows the percentage of high school mathematics teachers in each state by four age categories, with the states ordered by percentage under age 30. Kentucky, South Dakota, Arkansas, Hawaii, and North Carolina have over 20 percent under 30. Also shown is the increase or decrease in the proportion of mathematics teachers under 30 from 1990 to 1994. We can see that several states have increased the proportion of younger teachers over five points, including Arkansas, Hawaii, Delaware, Alabama, and Illinois.

Table 19: **Age of Mathematics Teachers, 1990 to 1994**

STATE	% Under Age 30	Change % Under 30 1990 to 1994	% Age 50 & Over	Change % Over 50 1990 to 1994
Kentucky	22	+3	15	+5
South Dakota	22	+4	22	0
Arkansas	21	+7	15	0
Hawaii	20	+6	23	+6
North Carolina	20	0	19	+9
Nebraska	19	–	22	–
North Dakota	18	-4	18	+5
Utah	18	+2	24	+2
Alabama	18	+5	18	+5
Oklahoma	18	+1	15	+4
Idaho	18	+1	21	+7
Mississippi	17	+3	19	+2
Ohio	17	+1	18	+5
Delaware	17	+8	23	-5
Missouri	17	-2	22	+7
Montana	16	+3	25	+6
Illinois	16	+5	28	+5
Iowa	16	+1	26	+8
Indiana	16	+1	22	+5
NATION	15	+2	23	+5
Nevada	14	+3	19	-3
Minnesota	13	+3	35	+6
Wisconsin	13	0	30	+9
New Mexico	13	+1	22	+2
Oregon	13	+1	23	+1
California	11	-2	31	+5
Pennsylvania	11	+2	28	+9
New York	10	+1	27	+7
Colorado	10	+1	26	+4
New Jersey	10	0	29	+10
Vermont	9	–	25	–
Rhode Island	7	+4	22	+7
Massachusetts	7	–	29	–
Connecticut	6	0	31	+11

– Data not available. Arkansas, Delaware = Main assignment only. Pennsylvania = grades 7–12.

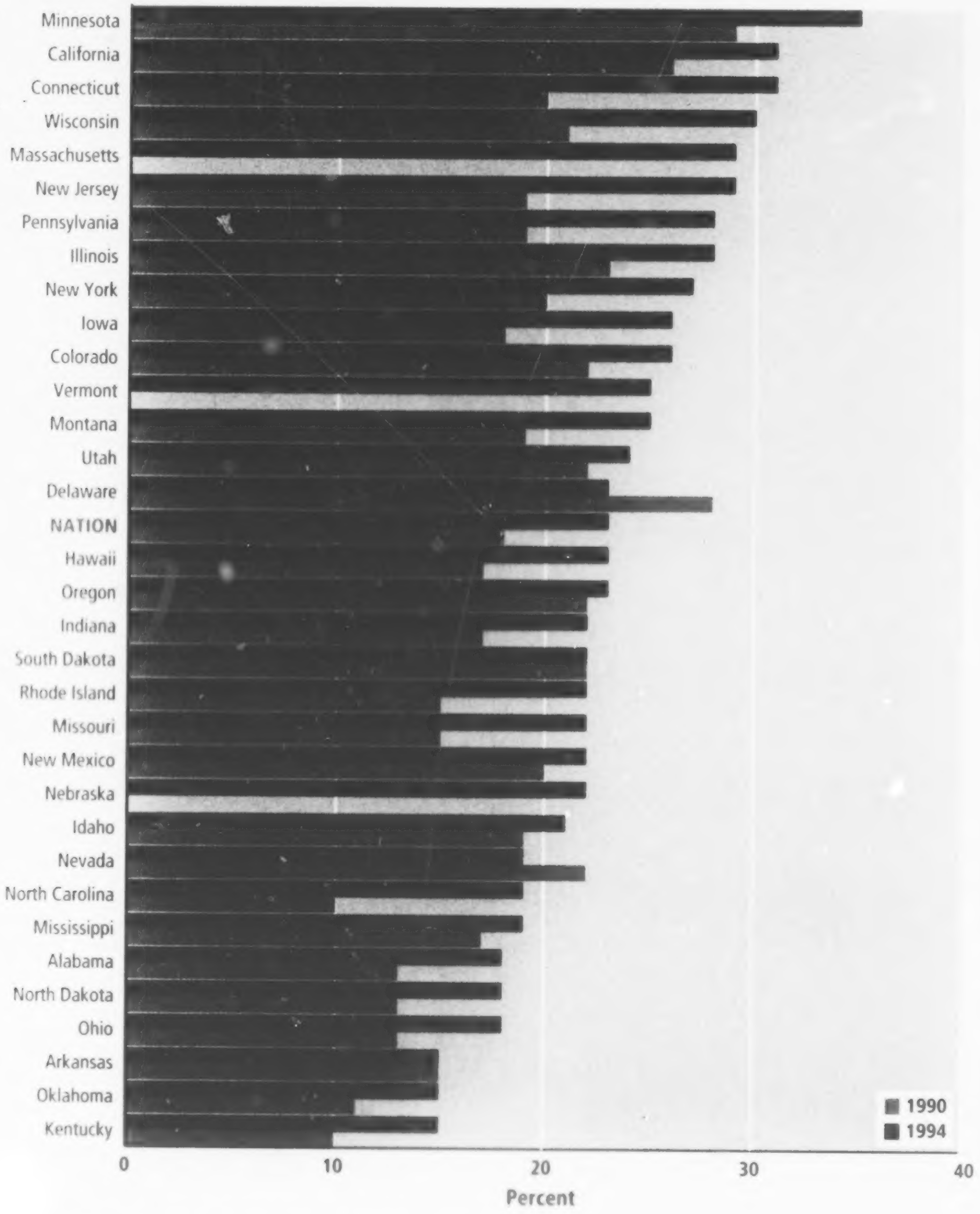
State Departments of Education, Data on Public Schools, 1993–94 school year.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 19 shows trends in the percentage of high school mathematics teachers over 50, and reveals that Minnesota, California, Connecticut, and Wisconsin have over 30 percent older math teachers.

The percentage of teachers over 50 has gone up about 10 points in Connecticut, Wisconsin, New Jersey, Pennsylvania, Iowa, and North Carolina since 1990.

Figure 19: **Mathematics Teachers Over Age 50, 1990 to 1994**



State Departments of Education, Data on Public Schools, 1993–94 school year

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

According to NCES projections, attrition rates from elementary and secondary teaching average 10 percent per year, but the period 1995 to 2000 will show higher rates of teacher retirement (NCES, 1994a). States that have flat or declining populations over the past two decades, particularly northeastern and midwestern states, have higher proportions of older science and mathematics teachers. Many of the teachers over 50 years of age in these states were hired in the 1960s when school enrollments were increasing.

Table 20 shows the percentages of younger and older physics teachers in each state, with the states ordered by percentage under age 30. Also shown is the increase or decrease in the percentage of physics teachers under 30 and over 50. We can see that several states have substantially increased the percentage of younger physics teachers since 1990, including Delaware, Nevada, Pennsylvania, and Oklahoma. The percentage of physics teachers over age 50 has gone up about 10 points since 1990 in Rhode Island, North Dakota, Delaware, Iowa, and Utah.

Table 20: **Age of Physics Teachers, 1990 to 1994**

STATE	% Under Age 30	Change % Under 30 1990 to 1994	% Age 50 & Over	Change % Over 50 1990 to 1994
Delaware	34	+17	38	+9
Hawaii	20	+5	27	+6
Kentucky	19	+3	20	+8
Alabama	18	+2	20	+2
Nebraska	16	–	28	–
North Carolina	15	0	19	+2
South Dakota	15	-7	25	+7
Indiana	15	+2	31	+6
Pennsylvania	15	+5	34	+8
Arkansas	14	+1	17	-5
Illinois	14	+2	29	-3
Missouri	14	0	24	+3
Iowa	13	-3	30	+9
Nevada	13	+6	19	-1
Ohio	13	0	21	+7
NATION	13	+1	29	+6
Idaho	12	-1	29	-2
Oklahoma	12	+5	25	+7
Wisconsin	12	+3	36	+6
Mississippi	11	+2	25	+5
Montana	11	-5	24	+7
Minnesota	11	+3	38	+5
New Jersey	10	+3	35	+7
New York	10	+3	34	+7
California	9	-5	31	+9
North Dakota	8	-6	29	+13
Utah	7	-3	28	+9
Massachusetts	6	–	36	–
New Mexico	5	-5	21	+4
Rhode Island	5	+3	30	+12
Connecticut	4	-3	37	+8
Vermont	0	–	29	–

– Data not available.
Delaware = Main assignment only
Pennsylvania = grades 7–12

State Departments of Education, Data on Public Schools, 1993–94 school year

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Chapter Four

Indicators of Context and Conditions for Teaching

- **Certified Teachers per 1,000 Students Taking Mathematics and Science**
- **Average Class Size in Mathematics and Science**
- **Instructional Resources and Materials**

State data on course enrollments aggregated to the nation show that in the 1993–94 school year 86 percent of public high school students were taking a course in mathematics, or a total of 10.2 million students taking mathematics. In addition, 91 percent of students in grades 7 and 8 were taking mathematics, or 6.2 million students. By comparison, during the 1989–90 school year 84 percent of high school students were taking mathematics. In 1993–94, there were 95,600 high school teachers of mathematics and 59,700 teachers of mathematics in grades 7 and 8 [estimated number of full-time equivalent (FTE) teachers].

In science, 80 percent of all public high school students were taking a science course during the 1993–94 school year, or 9.5 million students. In grades 7 and 8, 80 percent of students were taking science, or 5.4 million students. In 1989–90, 72 percent of high school students were taking a science course. In 1993–94, there were 98,500 teachers of high school science and 50,400 teachers of science in grades 7 and 8.

Number of Public Secondary Students and Teachers in Mathematics and Science, 1994

	Number of Students Enrolled		Number of Teachers (FTEs)	
	Grades 7–8	**9–12**	**7–8**	**9–12**
Math	6.2 million	10.2 million	59,700	95,600
Science	5.4 million	9.5 million	50,400	98,500

Source: State departments of education, public schools, 1994.

Considering these data on the size of public mathematics and science education, what do we know about the conditions for teaching in science and mathematics in our schools?

Policy Issues:

- *Do science and mathematics teachers have too many students to teach each day? Are class sizes too large?*
- *Do teachers have sufficient resources and materials to meet standards for science and mathematics instruction?*

Certified Teachers per 1,000 Students Taking Mathematics and Science

An indicator of conditions for teaching and learning mathematics and science is a ratio of the number of certified mathematics and science teachers per 1,000 students taking a subject. Table 21 shows teachers-per-1,000 ratios for the states that reported enrollments, teacher assignments, and certification for 1993–94. A high ratio (e.g., New Jersey math = 13.6) means the state has more certified high school mathematics teachers for the number of students taking high school mathematics than other states (e.g., in New Jersey, about 74 students per full-time equivalent teacher). The teachers/per students ratio can be used to assess how well supplied states are with certified teachers in a specific subject, and to identify needs for more certified teachers. Because of multiple assignments and certifications in science, we limited the state ratios for science to three fields.

The state ratios show that 11 of the reporting states have over 10 mathematics teachers per 1,000 students, or less than 100 students per certified teacher, including District of Columbia, New Jersey, Oklahoma, and Nebraska. A few states (e.g., Alabama, California, and Utah) have less than seven teachers per 1,000 students taking mathematics, or over 140 students per certified teacher.

Table 21: **Certified Teachers per 1,000 Students Taking Mathematics and Science, Grades 9–12, 1994**

STATE	Math	Biology	Chemistry	Physics
Dist. of Columbia	19.7	15.4	14.8	28.8
New Jersey	13.6	14.4	13.5	13.0
Oklahoma	12.1	13.0	14.1	15.7
Nebraska	12.1	11.7	10.3	11.9
Connecticut	11.0	11.9	12.6	12.7
Pennsylvania	10.9	9.8	10.4	13.2
North Dakota	10.9	9.9	10.4	15.3
Montana	10.9	10.8	11.5	15.7
Wyoming	10.8	16.0	22.2	39.0
Tennessee	10.3	7.9	9.9	8.4
Massachusetts	10.2	11.7	13.9	15.5
Arkansas	–	10.7	11.6	10.6
North Carolina	9.2	8.7	9.4	11.0
Delaware	8.9	6.9	7.0	21.5
Indiana	8.9	8.9	10.4	10.4
Kentucky	8.8	9.1	9.9	9.5
New York	8.8	17.2	12.6	13.4
Texas	8.8	15.4	10.5	12.3
Nevada	8.7	8.5	9.3	11.3
Idaho	8.6	8.5	7.6	10.2
Missouri	8.6	9.6	10.2	11.7
Ohio	8.4	8.1	9.7	11.4
New Mexico	8.3	9.0	9.2	10.1
Minnesota	8.2	8.6	7.8	9.5
Mississippi	8.1	7.0	7.9	7.3
Hawaii	8.0	8.1	7.1	8.7
Puerto Rico	7.9	2.0	10.3	10.2
Wisconsin	7.7	8.9	8.8	10.5
Louisiana	7.3	7.6	5.7	4.4
Alabama	6.4	4.9	5.1	8.9
California	6.1	6.4	6.3	6.6
Utah	6.0	5.5	4.5	4.1

Connecticut has an average of 11 certified full-time equivalent mathematics teachers for each 1,000 students taking mathematics in high school.

Ratio based on estimated number of certified FTE teachers assigned to subject divided by number of students enrolled in subject (in thousands).
Pennsylvania = grades 7–12.

State Departments of Education, Data on Public Schools, 1993–94 School Year.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

In science, states with over 15 teachers per 1,000 biology students, or less than 67 students per certified teacher, include District of Columbia, New York, Texas, and Wyoming. Five states have less than seven certified teachers per 1,000 biology students, or over 140 students per teacher: Mississippi, Puerto Rico, Alabama, California, and Utah.

This indicator provides a basic picture of how many students the average teacher in a state must work with during a given school day or week. States gain a general estimate of the current supply of certified teachers in relation to the enrollment demands from students.

Average Class Size in Mathematics and Science

Data from the 1991 Schools and Staffing Survey provide a state indicator of average class size in high school mathematics and science. This indicator gives a picture of what the typical teacher deals with in instructing high school science or mathematics classes.

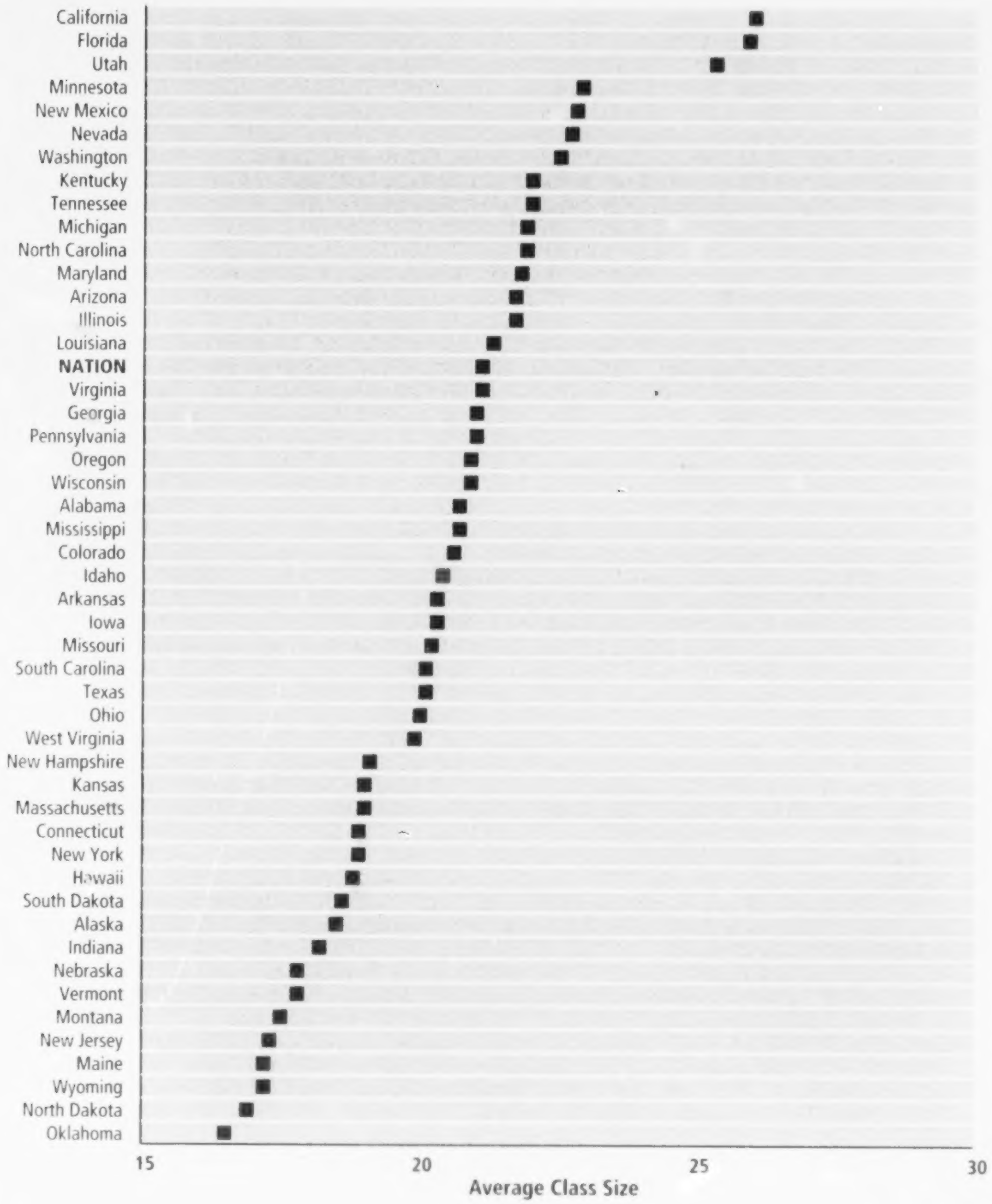
Figure 20 indicates that overall mathematics class sizes vary by state from an average of 16 students per class in Oklahoma and North Dakota to over 26 students per class in California and Florida. Thus, high school mathematics teachers work with over 50 percent larger classes in the high-growth states.

Figure 21 indicates that the average science class varies by state from 16 students per class in Montana and Wyoming to 28 students in Utah.

The national average as of 1991 was 21 students per high school mathematics class and 23 students per science class. From 1988 to 1991, the average mathematics class maintained the same number of students, while the average size in science increased from 22 to 23 students per class.

Further statistics on class size are reported in Appendix D. State averages were computed from SASS data for advanced math classes and for biology classes, to provide a comparison with all math classes and all science classes. In addition, the percentage of math and science classes with more than 30 students is reported by state. These statistics provide further depiction of the range of class sizes within states. For example, some states have a high percentage of classes over 30 students in advanced mathematics (Florida, California, Utah, Arizona), and these sizes are significantly over the average for the nation or the state.

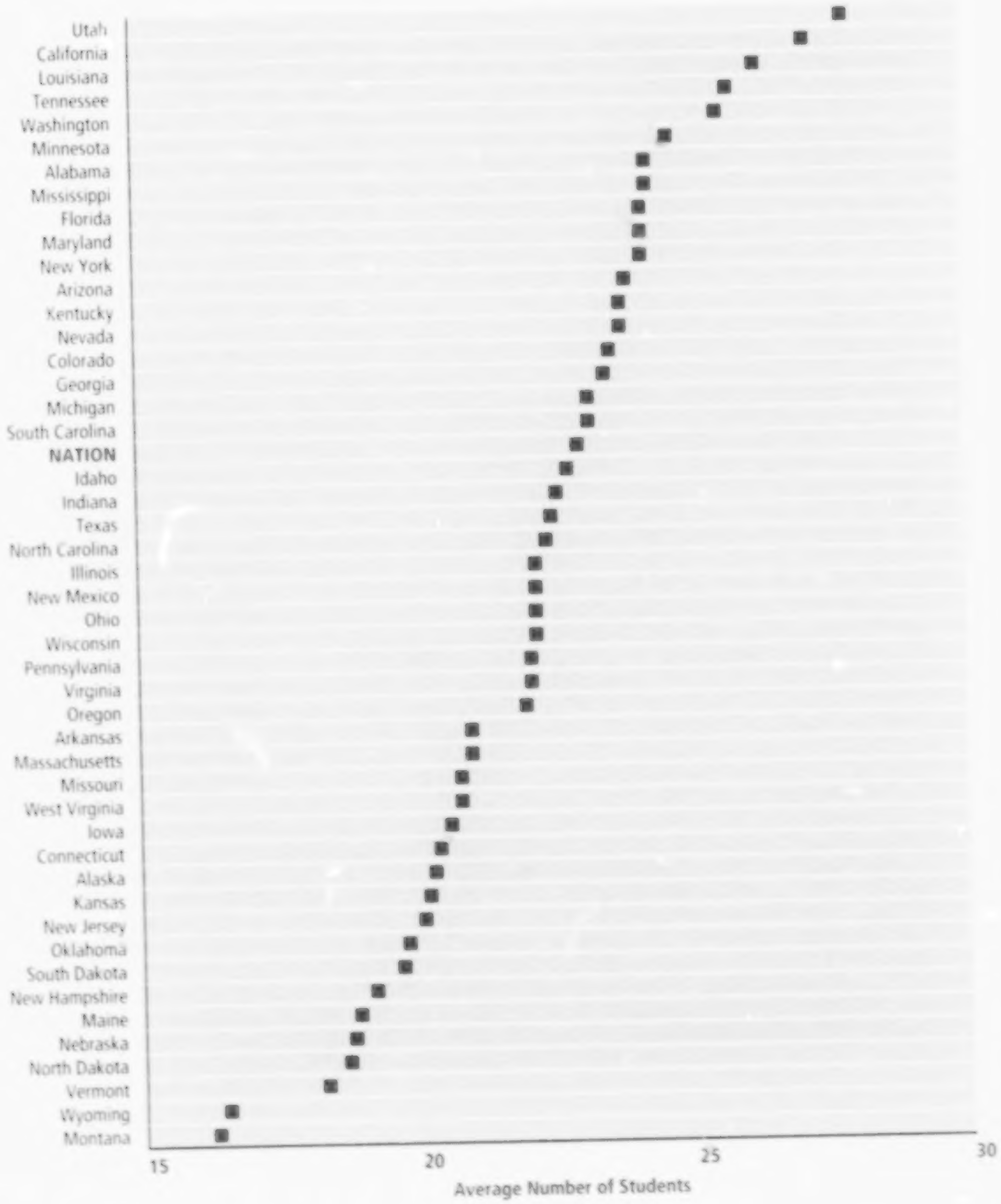
Figure 20: **Average Class Size in High School Mathematics, 1991**



NCES, Schools and Staffing Survey, Public School Teachers, 1990-91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Figure 21: **Average Class Size in High School Science, 1991**



Source: NCES Schools and Staffing Survey, Public School Teachers, 1990-91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Instructional Resources and Materials

The 1993 national survey on science and mathematics education (Weiss, 1994) provided national data on availability of instructional resources for science. State data on science resources are not yet available (the forthcoming NAEP 1996 Science results). A previous indicator reported on calculators used in mathematics instruction. Here we summarize national figures on perceived problems with science teaching resources and materials, as well as national statistics on money spent on resources and materials for teaching science and mathematics.

Elementary school principals and secondary school department heads were asked to report serious problems for science instruction in their school, as of fall 1993. The findings (from Weiss, 1994) show that instructional resources were at the top of the problems list, with the following percentages of schools indicating a problem:

Major Resource Problems for Science Instruction

Problem	% of all schools
Funds for purchasing equipment and supplies	43
Appropriate computer software	42
Materials for individualizing instruction	36
Access to computers	30
Facilities	25

Source: Weiss, 1994

In the same survey, schools across the United States were asked to report the amount of money that was spent on science and mathematics supplies and equipment.

Expenditures for Type of Resources and Materials

	Average Annual Spending
Computer software—Mathematics	$100.00 per school
Computer software—Science	$50.00 per school
Science supplies—Elementary	$0.51 per student
Science supplies—Middle grades	$0.88 per student
Math manipulatives—Elementary	$1.00 per student
Math materials—Middle grades	$0.40 per student

Source: Weiss, 1994

The average school spent only $50 on science computer software and $100 on mathematics software (the price of one piece of software is about $100).

The average elementary school spent only 51 cents per student on science consumable supplies (e.g., chemicals, batteries, glassware), and the typical middle school spent only 88 cents per student.

In mathematics, the average elementary school spent only $1 per student on math materials and manipulatives, and middle schools average only 40 cents per student on mathematics materials. These data on average expenditures clearly show why teachers see lack of resources and materials as a key problem in science instruction.

Conclusions

Use of Science and Mathematics Indicators to Analyze Policies

Educators and policymakers who read reports providing statistical indicators on education are faced with the question of how to interpret the statistics in relation to current questions about the quality of education and how to use the indicators to examine current and proposed policy initiatives. The science and mathematics indicators outlined in this report can be helpful in analyzing education policies at state, national, and local levels. Following are suggestions for use of the indicators in analyzing education policies.

The intent of the Council and NSF is to provide a report of science and mathematics indicators that would meet a variety of needs for information. At the same time, decisions we made about how indicators are selected, designed, and presented in the report does shape how the information can be used.

We chose not to compute and provide a composite indicator that would give a summary score for states across a number of individual indicators. The development of educational indicators has not reached the level of consensus among policymakers, researchers, and educators to make effective use of such a composite indicator. State users of indicators have expressed strong interest in having indicators reported individually to allow for different applications and interpretations.

We continue to hear expressed a need for indicators in at least three broad categories: (a) student achievement and outcomes, (b) school processes, content, and instructional practices, and (c) conditions or context for teaching and learning. Since our work on science and mathematics indicators began in 1986, several individual indicators have developed, changed, or been added, but these broad categories continue to be used.

Uses for analyzing education policies are central to the design for the 1995 report. First, we report state-by-state results on student achievement. The Council voted in 1984 to support state-by-state reporting of state achievement results if they are valid, comparable, and reliable. In this report, the statistics on NAEP mathematics assessments and advanced placement examinations in this report allow the reader to analyze state-to-state differences in achievement and examine trends for individual states. In addition, student scores are reported in relation to standards for performance, that is, the knowledge and skills students should have by a given grade level.

Policies on instructional time and course credits can also be analyzed with the state science and mathematics indicators. Policy reforms in the 1980s aimed to increase the amount of time in elementary and secondary school that students study core academic subjects, such as mathematics and science. The 1995 CCSSO report provides statistics for examining differences by state in time spent on elementary mathematics and science. Secondary course enrollments in science and mathematics are compared across different levels of state requirements. In addition to simply tabulating the number of courses students take in science and mathematics to meet requirements, we report the rate at which students are progressing to higher-level courses in science and mathematics. This approach to reporting indicators of course taking incorporates a standard of all students learning challenging subject content in science and mathematics by graduation. This kind of standard reflects the direction many states are now taking toward reform of mathematics and science.

States are currently examining policies and programs concerning initial preparation and professional development of teachers and administrators. An important issue is the use of state standards for content knowledge and instructional skills to guide preparation of educators. This state report on indicators applies one standard of whether current secondary science and mathematics teachers have a major in their assigned teaching field. We also report a state indicator based on statistics on mathematics teachers' preparation in content areas recommended in the NCTM *Standards*. Finally, teacher preparation is often assessed by the proportion of teachers that have state certification in their assigned field, and we analyze the rate of certification for middle-level and high school teachers.

Science and mathematics education reform emphasizes learning through doing and active involvement of students in application of knowledge, hands-on laboratory experiences, and projects. The 1995 indicators provide reliable information on the use of calculators and math manipulatives and on the needs for classroom resources and materials in science and mathematics to support active instruction. The indicators can have a role in examining policies that would provide support for science and mathematics reform efforts through key resources and materials.

The format of the 1995 CCSSO report is intended to assist in the use of state indicators, such as inclusion of full-page tables and graphics that can be photocopied as transparencies. We also provide detailed state-level data in Appendixes which may be a source for further analyses; and several key indicators are reported for large cities participating in the Urban Systemic Initiatives supported by NSF. The CCSSO indicators will be available to all users in electronic form, either through personal computer diskettes or electronic access to our bulletin board on science and math indicators.

List of Abbreviations

AAAS	American Association for the Advancement of Science
AP	Advanced Placement
CCSSO	Council of Chief State School Officers
ECS	Education Commission of the States
ETS	Educational Testing Service
FTE	Full-Time Equivalent
NAEP	National Assessment of Educational Progress
NCES	National Center for Education Statistics,U.S. Department of Education
NCEST	National Council on Education Standards and Testing
NCTM	National Council of Teachers of Mathematics
NEGP	National Education Goals Panel
NGA	National Governors' Association
NRC	National Research Council
NSF	National Science Foundation
NSTA	National Science Teachers Association
OERI	Office of Educational Research and Improvement, U.S. Department of Education
PSA	Policy Studies Associates
SASS	Schools and Staffing Survey
SES	Socioeconomic Status
SSI	Statewide Systemic Initiatives
TIMSS	Third International Mathematics and Science Study
USI	Urban Systemic Initiatives

Appendix A
Student Background Characteristics

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Appendix A 1: **Percentage of Public School Students by Race/Ethnicity, by State, Fall 1992**

STATE	% Minority K-12	% White	% Black	% Hispanic	% Asian	% American Indian
Alabama	37	63	36	0.3	0.6	0.8
Alaska	34	66	5	2	4	23
Arizona	40	60	4	27	2	7
Arkansas	26	74	24	0.7	0.7	0.3
California	57	43	9	36	11	0.8
Colorado	26	75	5	17	2	1
Connecticut	26	74	13	11	2	0.2
Delaware	33	67	28	3	2	0.2
Dist. of Columbia	96	4	89	6	1	*
Florida	40	60	24	13	2	0.2
Georgia	37	63	35	1	1	*
Hawaii	76	24	3	5	68	0.3
Idaho	8	93	*	5	1	1
Illinois	35	65	21	11	3	0.1
Indiana	14	86	11	2	0.7	0.1
Iowa	6	94	3	2	1	0.4
Kansas	16	84	8	5	2	0.9
Kentucky	10	90	10	0.2	0.5	*
Louisiana	48	52	45	1	1	0.4
Maine	3	97	1	*	1	1
Maryland	40	60	34	3	4	0.3
Massachusetts	20	80	8	9	4	0.2
Michigan	22	78	17	2	1	1
Minnesota	10	90	4	2	3	2
Mississippi	52	48	51	0.2	0.5	0.4
Missouri	17	83	16	0.8	0.9	0.2
Montana	12	88	0.5	1	0.7	9
Nebraska	11	89	5	3	1	1
Nevada	28	72	9	13	4	2
New Hampshire	3	97	0.8	1	1	0.2
New Jersey	36	64	19	13	5	0.1
New Mexico	59	41	2	46	0.9	10
New York	41	59	20	16	5	0.3
North Carolina	34	66	30	1	1	2
North Dakota	9	91	0.7	0.7	0.7	7
Ohio	17	83	15	1	1	0.1
Oklahoma	28	73	10	3	1	13
Oregon	13	88	2	5	3	2
Pennsylvania	18	82	14	3	2	0.1
Rhode Island	18	82	7	8	3	0.4
South Carolina	43	57	41	0.5	0.6	0.2
South Dakota	14	86	0.7	0.5	0.7	12
Tennessee	24	76	23	0.4	0.8	0.1
Texas	52	48	14	35	2	0.2
Utah	8	92	0.6	4	2	1
Vermont	2	98	0.6	0.3	0.6	0.8
Virginia	32	69	26	3	3	0.2
Washington	19	81	4	6	6	3
West Virginia	5	95	4	0.2	0.4	0.1
Wisconsin	15	85	9	3	2	1
Wyoming	10	90	0.9	6	0.7	3
NATION	33	67	17	12	4	1

* Less than 0.05 percent

NCES, Schools and Staffing Survey, 1990–91 (for Georgia, Idaho, Maine) and NCES, Common Core of Data Survey, Fall 1992

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Appendix A.2: **Enrollment in Public Elementary and Secondary Schools, Fall 1993; and Percent of Children in Poverty, 1993**

STATE	Grades K–6	Grades 7–8	Grades 9–12	% in Poverty
Alabama	405,225	122,148	198,651	20.5
Alaska	71,802	19,012	32,347	9.5
Arizona	409,720	109,334	182,737	23.1
Arkansas	241,254	73,363	125,801	25.4
California	2,993,955	778,776	1,393,530	25.7
Colorado	354,636	96,833	164,260	11.3
Connecticut	281,571	70,789	127,655	14.9
Delaware	59,049	17,003	28,930	13.7
Dist. of Columbia	43,574	10,329	17,854	49.3
Florida	1,173,441	306,960	525,569	26.9
Georgia	708,136	196,755	324,879	17.5
Hawaii	104,198	26,853	48,728	13.4
Idaho	126,287	38,541	69,287	14.2
Illinois	984,513	274,881	503,024	18.2
Indiana	513,528	156,469	282,214	10.8
Iowa	256,334	77,409	142,601	11.1
Kansas	252,099	72,815	127,081	16.0
Kentucky	339,995	102,839	184,356	25.7
Louisiana	428,093	118,075	202,283	39.4
Maine	120,600	32,381	59,632	17.7
Maryland	431,147	113,692	197,072	13.4
Massachusetts	498,253	127,091	232,208	16.4
Michigan	870,289	236,125	423,081	24.3
Minnesota	442,680	127,644	233,253	12.3
Mississippi	274,505	82,511	131,112	31.1
Missouri	468,383	133,308	241,874	20.4
Montana	89,390	26,119	46,111	14.5
Nebraska	154,100	45,749	81,671	13.5
Nevada	136,847	36,244	60,727	13.9
New Hampshire	105,252	29,115	49,098	13.8
New Jersey	614,558	161,401	288,263	16.4
New Mexico	173,599	50,755	87,768	18.8
New York	1,430,465	383,262	743,933	24.6
North Carolina	626,295	172,521	305,060	17.8
North Dakota	64,454	19,058	35,000	9.9
Ohio	981,074	287,390	517,122	18.8
Oklahoma	340,535	93,877	162,511	23.5
Oregon	285,383	80,105	147,819	14.9
Pennsylvania	946,481	264,632	496,382	17.8
Puerto Rico	348,047	107,025	162,371	—
Rhode Island	81,817	21,786	38,470	20.3
South Carolina	356,073	103,634	176,745	26.7
South Dakota	77,023	23,031	39,971	16.6
Tennessee	471,212	131,829	236,542	30.5
Texas	1,999,851	560,756	927,209	22.9
Utah	245,721	75,559	137,235	15.1
Vermont	57,494	15,310	27,377	14.2
Virginia	575,734	158,939	278,009	11.6
Washington	511,565	143,772	255,528	12.3
West Virginia	157,756	51,334	96,264	31.4
Wisconsin	448,283	130,164	248,284	16.0
Wyoming	54,887	16,515	29,497	11.4
NATION	24,187,163	6,711,818	11,874,986	20.8

Source: U.S. Department of Education, NCES, Common Core of Data, State Nonfiscal Survey and Bureau of the Census, 1993–94 CPS unpublished data.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix A.3: Number of Public Elementary and Secondary Teachers, Fall 1993; and Current Expenditures per Pupil

STATE	Elementary Teachers	Secondary Teachers	Current Expenditures ($)
Alabama	19,858	19,073	4,061
Alaska	4,296	2,491	9,811
Arizona	25,425	10,305	4,240
Arkansas	11,833	12,208	3,949
California	124,684	56,384	4,640
Colorado	16,079	16,222	5,254
Connecticut	18,476	9,345	8,429
Delaware	3,021	3,121	6,587
Dist. of Columbia	2,744	2,259	8,632
Florida	41,126	40,876	5,356
Georgia	48,752	20,739	4,473
Hawaii	5,200	4,328	5,936
Idaho	5,709	5,642	4,208
Illinois	59,928	28,207	5,520
Indiana	25,223	24,948	5,517
Iowa	16,254	12,188	5,264
Kansas	13,513	12,561	5,652
Kentucky	24,538	11,146	5,163
Louisiana	23,352	10,377	4,807
Maine	9,460	4,904	6,046
Maryland	23,194	19,144	6,502
Massachusetts	19,732	29,367	6,802
Michigan	30,429	36,419	6,538
Minnesota	22,374	22,949	5,770
Mississippi	16,969	9,184	3,512
Missouri	25,713	25,814	4,598
Montana	6,265	3,036	5,276
Nebraska	10,131	8,372	5,108
Nevada	5,987	4,648	5,029
New Hampshire	7,741	3,913	5,687
New Jersey	43,764	26,509	10,112
New Mexico	9,570	4,564	4,966
New York	78,199	63,453	8,899
North Carolina	33,832	24,935	4,952
North Dakota	4,850	2,544	4,449
Ohio	66,911	36,103	6,212
Oklahoma	17,076	16,180	4,155
Oregon	13,405	8,716	6,068
Pennsylvania	41,657	43,358	7,197
Puerto Rico	20,657	14,596	–
Rhode Island	4,083	4,103	6,764
South Carolina	24,590	12,368	4,798
South Dakota	5,559	2,589	4,738
Tennessee	28,945	12,398	4,361
Texas	98,715	82,139	5,379
Utah	8,147	7,780	3,419
Vermont	2,909	3,140	7,212
Virginia	38,242	28,015	5,357
Washington	21,882	17,533	5,782
West Virginia	9,150	7,394	5,799
Wisconsin	29,040	17,237	6,919
Wyoming	3,006	3,322	5,797
NATION	**1,251,538**	**894,550**	**5,730**

SOURCE: U.S. Department of Education, NCES, Common Core of Data, State Nonfiscal Survey, 1993–94; and National Education Association Rankings of the States, 1994, West Haven, CT.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Appendix A.4 Parents' Highest Level of Education Reported by Grade 8 Students, 1992 NAEP Mathematics

STATE	Graduated College % of Students	Some Education After High School % of Students	Graduated High School % of Students	Did Not Finish High School % of Students	"I Don't Know" % of Students
Alabama	33	18	29	13	7
Arizona	36	22	21	10	12
Arkansas	30	20	31	11	8
California	39	18	17	10	16
Colorado	46	19	21	6	7
Connecticut	47	16	22	6	9
Delaware	39	18	30	6	8
Dist. of Columbia	32	17	29	9	12
Florida	39	19	24	8	10
Georgia	35	18	30	11	6
Hawaii	38	15	25	6	16
Idaho	48	20	19	7	6
Indiana	33	21	32	8	6
Iowa	44	21	25	4	5
Kentucky	28	19	32	15	6
Louisiana	32	20	30	10	7
Maine	40	22	26	6	5
Maryland	44	18	25	6	7
Massachusetts	48	17	21	7	7
Michigan	38	23	26	6	7
Minnesota	48	21	22	3	7
Mississippi	36	16	29	13	7
Missouri	36	22	29	8	6
Nebraska	46	20	24	4	6
New Hampshire	46	17	24	6	7
New Jersey	45	18	23	7	8
New Mexico	34	20	26	11	10
New York	44	18	23	6	10
North Carolina	36	20	27	10	6
North Dakota	54	18	19	3	5
Ohio	37	19	32	7	5
Oklahoma	39	21	26	8	6
Pennsylvania	39	19	30	7	5
Rhode Island	43	18	22	8	8
South Carolina	37	16	31	9	7
Tennessee	33	21	29	12	5
Texas	34	18	21	16	11
Utah	53	22	15	3	7
Virginia	41	18	24	9	8
West Virginia	29	18	33	13	7
Wisconsin	38	24	28	5	6
Wyoming	42	22	23	5	7
NATION	40	18	25	8	9

States not participating in 1992 NAEP: Alaska, Illinois, Kansas, Montana, Nevada, Oregon, South Dakota, Vermont, Washington.

[illegible] National Center for Education Statistics, Data Compendium for the NAEP 1992 Mathematics Assessment of the Nation and the States. Washington, DC: U.S. Department of Education.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Appendix B
NAEP Sample Exercises in Mathematics
Student Proficiency by Content Areas

Contents **Page**

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Appendix B.2 Average 8th Grade Proficiency in Mathematics Content Areas, 1992 NAEP Assessment B-90

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Grade 4: Numbers/Operations

Lynn had only quarters, dimes, and nickels to buy her lunch. She spent all of the money and received no change. Could she have spent $1.98?

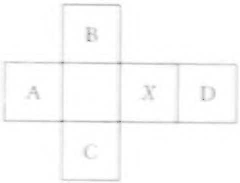
Yes No

Give a reason for your answer.

Overall Percent Correct
Grade 4: 20 (0.9)

Conditional-Proficient
Grade 4: 48%

Grade 4: Geometry



The squares in the figure above represent the faces of a cube which has been cut along some edges and flattened. When the original cube was resting on face *X*, which face was on top?

1. A
2. B
3. C
4. D

Overall Percent Correct
Grade 4: 22 (1.4)

Conditional-Advanced
Grade 4: 90%

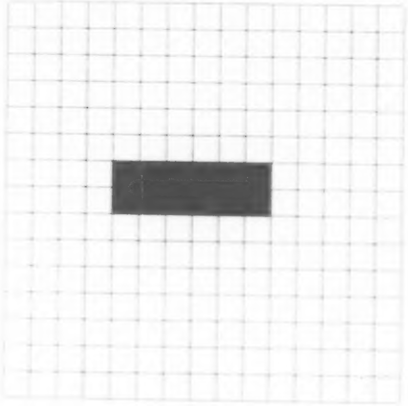
Note:
Conditional percentages show, of the students who performed in the interval between that achievement level and the next highest achievement level, what percentage of those students were successful in answering the question.

* *The standard errors of the estimated percentages appear in parentheses.*

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card.

Grades 4 and 8: Measurement, Constructed Response

On the grid below, draw a rectangle with an area of 12 square units



☐ = 1 square unit

Overall Percent Correct
Grade 4: 42 (1.4)
Grade 8: 66 (1.5)

Grade 8: Numbers/Operations

Jill needs to earn $45.00 for a class trip. She earns $2.00 each day on Mondays, Tuesdays, and Wednesdays, and $3.00 each day on Thursdays, Fridays, and Saturdays. She does not work on Sundays. How many weeks will it take her to earn $45.00?

Answer:

Overall Percent Correct
Grade 8: 59 (1.4)

Conditional-Basic
Grade 8: 64%

Grade 8: Numbers/Operations

Which of the following is both a multiple of 3 and a multiple of 7?

- A 7,007
- B 8,192
- C 21,567
- D 22,287
- E 40,040

Did you use the calculator on this question? Yes No

Overall Percent Correct
Grade 8: 77 (1.2)

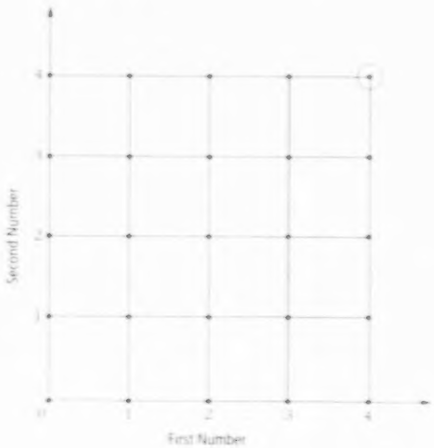
Conditional-Basic
Grade 8: 83%

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card.

Grades 4 and 8: Algebra and Functions, Constructed Response

On the grid below, the dot at (4,4) is circled. Circle two other dots where the first number is equal to the second number.

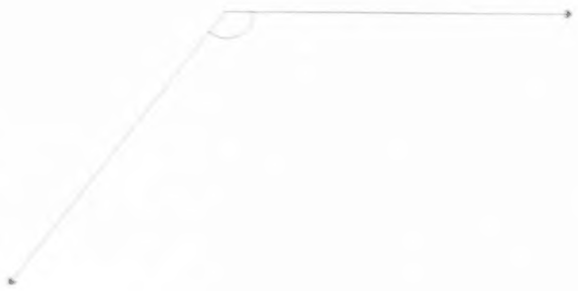
Overall Percent Correct
Grade 4: 38 (1.6)
Grade 8: 75 (1.3)



Grade 8: Geometry

Overall Percent Correct
Grade 8: 35 (1.9)

Conditional-Basic
Grade 8: 37%



Use your protractor to find the degree measure of the angle shown above.

Answer:

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card

Grade 8: Numbers/Operations

Tracy said, "I can multiply 6 by another number and get an answer that is smaller than 6."

Pat said, "No, you can't. Multiplying 6 by another number always makes the answer 6 or larger."

Who is correct? Give a reason for your answer.

Overall Percent Correct
Grade 8: 48 (1.4)

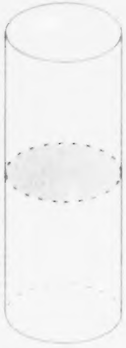
Conditional-Proficient
Grade 8: 73%

Did you use the calculator on this question? Yes No

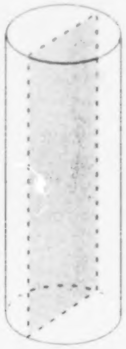
Grade 8: Geometry, Constructed Response

Each of the cylinders shown below was cut in a different way. The shaded part shows the shape of the cut. Under each figure, write the name of the shape of the cut.

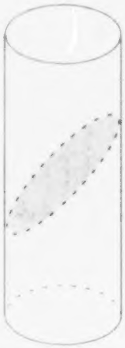
Overall Percent Correct
Grade 8: 48 (1.3)



Answer:



Answer:



Answer:

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card.

Grade 8: Algebra and Functions, Constructed Response

54 < 3 x ☐

Write two numbers that could be put in the equation to make the number sentence above true.

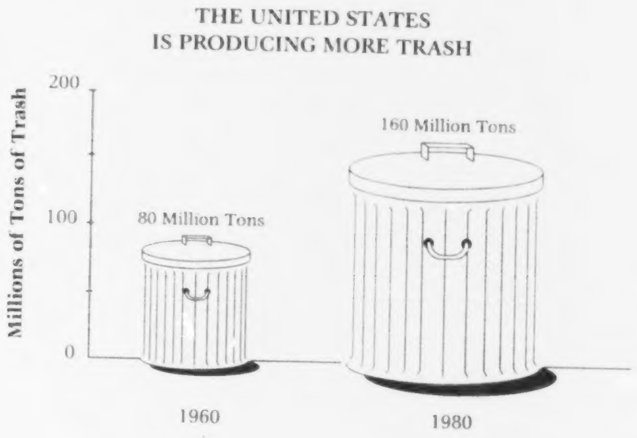
Answer:

Overall Percent Correct
Grade 8: 49 (1.6)

Grade 8: Geometry, Constructed Response

Overall Percent Correct
Grade 8: 8 (0.8)

Conditional-Advanced
Grade 8: 42



The pictograph shown above is misleading. Explain why.

Answer:

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card.

Grade 8: Data Analysis/Statistics

A	*B*
2	5
4	9
6	13
8	17
14	?

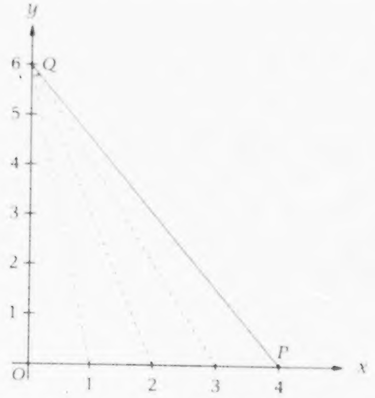
If the pattern shown in the table were continued, what number would appear in the box at the bottom of column *B* next to 14?

A 19
B 21
C 23
D 25
E 29

Overall Percent Correct
Grade 8: 25 (1.3)

Conditional-Advanced
Grade 8: 79%

Grade 12: Algebra/Functions



In the figure above, point *Q* is fixed and point *P* starts at 4 and moves left along the x-axis. As *P* moves left along the x-axis toward *O*, the area of $\triangle POQ$ changes.

Use the information given to complete the table below to show how the area of $\triangle POQ$ changes as *P* goes from the position shown to the origin *O*.

x-coordinate of *P*	**Area of $\triangle POQ$**
4	
3	
2	
1	
0	

Overall Percent Correct
Grade 12: 29 (1.5)

Conditional-Advanced
Grade 12: 89%

Source: Dossey et al. (1993). Can students do mathematical problem solving?; Mullis et al. (1993). 1992 NAEP Mathematics Report Card.

Appendix B.2: Average Grade 8 Proficiency in Mathematics Content Areas, 1992 NAEP Assessment

STATE	Numbers and Operations	Measurement	Geometry	Data Analysis, Statistics, and Probability	Algebra and Functions	Estimation
Alabama	258	245	245	250	253	260
Arizona	269	264	260	265	264 ◆	269
Arkansas	262	251	250	254	255	263
California	263	258 ◆	259	258	258	263
Colorado	273 ◆	273 ◆	269	274	270 ◆	273
Connecticut	277	275 ◆	268	274	270	275
Delaware	267	258	257	262	263	264
Dist. of Columbia	243 ◆	221	231	229 ◆	237	241
Florida	264	254	255	259	260	264
Georgia	265	253	253	259	259	263
Hawaii	261 ◆	254 ◆	257 ◆	249 ◆	256 ◆	260
Idaho	277	276 ◆	271	274	274 ◆	274
Indiana	272	269	266	273	267	271
Iowa	285	287 ◆	278	285	280 ◆	282
Kentucky	266 ◆	259 ◆	256	262	260	266
Louisiana	256	242	244	248	249	258
Maine	280	282	274	282	274	275
Maryland	269	261	259	266	264	264
Massachusetts	276	270	267	274	271	275
Michigan	270	266	261	268	267	268
Minnesota	282	285 ◆	278 ◆	284 ◆	281 ◆	284
Mississippi	256	236	239	243	245	259
Missouri	272	271	266	272	270	271
Nebraska	279	278	274	278	275	277
New Hampshire	280 ◆	280 ◆	273	281 ◆	274	277
New Jersey	276	268	265	271	272	274
New Mexico	263 ◆	257	256	258	257	265
New York	270 ◆	262	261	268	265	266
North Carolina	261 ◆	253 ◆	254 ◆	258 ◆	259 ◆	263
North Dakota	286	285	277	286	279	283
Ohio	272	266	262	270	267	269
Oklahoma	271	266 ◆	262	269	267	271
Pennsylvania	274	271	265	273	270	272
Rhode Island	269 ◆	263 ◆	259 ◆	266 ◆	266 ◆	269
South Carolina	265	257	256	258	259	264
Tennessee	264	253	252	259	257	264
Texas	267	260 ◆	262	263	266 ◆	267
Utah	276	275	269	275	272	274
Virginia	272	265	261	268	267	271
West Virginia	263	256	254	260	257	263
Wisconsin	280	279	272	280	275	278
Wyoming	276	278 ◆	272	275	271	276
Guam	240	228	239	221 ◆	235 ◆	244
Virgin Islands	231	211	222	214 ◆	221	231
NATION	**272** ◆	**266** ◆	**263** ◆	**268** ◆	**267** ◆	**271**

Note: ◆ Significantly higher than 1990 NAEP mathematics proficiency at about the 95% confidence level.

Source: Mullis et al. (1993). NAEP 1992 Mathematics Report Card (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix B.3: Average Grade 4 Proficiency in Mathematics Content Areas, 1992 NAEP Assessment

STATE	Numbers and Operations	Measurement	Geometry	Data Analysis, Statistics, and Probability	Algebra and Functions	Estimation
Alabama	204	213	209	209	204	198
Arizona	210	219	219	214	213	205
Arkansas	205	215	212	211	206	197
California	204	210	213	206	208	202
Colorado	216	225	227	220	217	212
Connecticut	223	230	230	225	225	217
Delaware	214	220	219	219	215	203
Dist. of Columbia	183	193	198	189	191	171
Florida	208	219	215	214	211	200
Georgia	211	219	216	218	213	199
Hawaii	211	216	218	212	210	199
Idaho	216	227	226	219	217	211
Indiana	216	226	223	222	218	210
Iowa	227	234	229	230	226	221
Kentucky	211	218	215	215	212	205
Louisiana	199	208	206	204	201	188
Maine	227	236	236	231	228	220
Maryland	214	220	219	217	215	200
Massachusetts	224	229	229	225	222	217
Michigan	215	225	222	218	216	209
Minnesota	225	233	230	227	225	223
Mississippi	198	206	202	199	195	188
Missouri	217	226	224	223	220	211
Nebraska	221	230	229	225	220	216
New Hampshire	225	234	233	229	227	222
New Jersey	225	230	226	225	224	213
New Mexico	207	216	219	214	210	203
New York	215	221	218	221	215	204
North Carolina	208	216	215	214	210	198
North Dakota	224	235	229	229	225	222
Ohio	214	223	221	218	216	210
Oklahoma	216	224	220	221	217	211
Pennsylvania	221	229	223	223	221	212
Rhode Island	212	218	216	213	212	206
South Carolina	208	218	215	211	207	195
Tennessee	207	213	211	211	209	200
Texas	214	220	220	218	216	199
Utah	219	229	227	221	221	213
Virginia	217	224	222	223	217	206
West Virginia	210	223	217	214	211	204
Wisconsin	225	234	228	229	225	219
Wyoming	221	230	228	224	222	216
Guam	188	192	201	189	192	173
NATION	214	222	220	218	216	206

Source: Mullis et al. (1993). NAEP 1992 Mathematics Report Card (see for standard errors of estimates).

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix B.4: Students Taking Advanced Placement (AP) Exams in Mathematics and Science (1994)

STATE	AP Calculus Total Taking Exam	% of Grade 12	AP Biology Total Taking Exam	% of Grade 12	AP Chemistry Total Taking Exam	% of Grade 12	AP Physics Total Taking Exam	% of Grade 12
Alabama	1,155	3	522	1	298	1	240	1
Alaska	238	3	108	2	52	1	25	0.4
Arizona	1,224	3	551	1	374	1	464	1
Arkansas	341	1	137	1	100	0.4	21	0.1
California	16,023	6	7,791	3	3,933	1	4,562	2
Colorado	1,558	4	649	2	469	1	325	1
Connecticut	1,672	6	910	3	567	2	607	2
Delaware	397	7	205	3	149	3	108	2
Dist. of Columbia	290	9	169	5	90	3	171	5
Florida	5,735	6	2,634	3	1,816	2	1,886	2
Georgia	3,497	6	1,635	3	1,168	2	960	2
Hawaii	640	6	242	2	226	2	271	3
Idaho	310	2	167	1	91	1	45	0.3
Illinois	5,779	5	2,252	2	1,707	2	2,030	2
Indiana	3,434	6	1,427	2	1,460	2	881	1
Iowa	509	2	160	0	127	0.4	46	0.1
Kansas	355	1	93	0	78	0.3	59	0.2
Kentucky	923	2	658	2	285	1	134	0.4
Louisiana	573	1	252	1	112	0.3	140	0.4
Maine	419	3	230	2	93	1	131	1
Maryland	2,719	7	1,219	3	1,027	3	779	2
Massachusetts	3,384	7	1,852	4	857	2	1,054	2
Michigan	3,244	4	1,630	2	1,145	1	793	1
Minnesota	1,297	2	361	1	187	0.3	143	0.3
Mississippi	355	1	230	1	55	0.2	63	0.2
Missouri	926	2	429	1	357	1	234	0.5
Montana	99	1	96	1	26	0.3	13	0.1
Nebraska	297	2	136	1	44	0.2	26	0.1
Nevada	367	3	137	1	158	1	76	1
New Hampshire	577	5	167	2	90	1	133	1
New Jersey	4,533	7	2,553	4	1651	3	13,64	2
New Mexico	564	3	189	1	127	1	153	1
New York	12,120	8	7,698	5	3,005	2	3,828	3
North Carolina	3414	6	1867	3	982	2	769	1
North Dakota	77	1	60	1	19	0.2	12	0.1
Ohio	3,718	3	1347	1	1,139	1	869	1
Oklahoma	585	2	163	0	287	1	150	0.4
Oregon	554	2	304	1	147	0.4	126	0.4
Pennsylvania	3,606	3	1,725	2	1,243	1	1,074	1
Rhode Island	292	4	162	2	63	1	60	1
South Carolina	2,321	7	1,188	3	579	2	301	1
South Dakota	53	1	42	0	36	0.4	8	0.1
Tennessee	1,559	3	813	2	412	1	328	1
Texas	4,778	3	1,838	1	1,232	1	1,074	1
Utah	2,394	8	1,578	5	727	2	550	2
Vermont	248	4	226	4	52	1	42	1
Virginia	3,939	7	1,872	3	1,021	2	709	1
Washington	1,315	2	395	1	273	0.5	186	0.3
West Virginia	398	2	199	1	147	1	65	0.3
Wisconsin	1,680	3	539	1	381	1	246	0.5
Wyoming	213	3	41	1	10	0.2	9	0.1
NATION	107,078	4	51,848	2	30,674	1	28,343	1

Note: State totals include public and private schools.

Source: The College Board (1994). Advanced Placement Program, National and 50 States Summary.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C
Science and Mathematics Course Enrollments

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Appendix C.1: State Curriculum Frameworks and Content–Related Documents in Mathematics and Science, December, 1994

STATE	Mathematics Curriculum Framework	Science Curriculum Framework
Alabama	In place (1989)	In place (1989) Developing
Alaska	Developing	Developing
Arizona	In place (1992) Developing	In place (1990) Developing
Arkansas	In place (Draft, 1993)	Developing
California	In place (1992)	In place (1990)
Colorado	In place (Draft, 1994) Developing	In place (Draft, 1994) Developing
Connecticut	In place (1981) Developing	In place (1991) Developing
Delaware	In place (Draft, 1994) Developing	In place (Draft, 1994) Developing
Dist. of Columbia	In place (1993) Developing	In place (1993) Developing
Florida	Developing	In place (1994)
Georgia	In place (1988) Developing	In place (1988) Developing
Hawaii	Developing	Developing
Idaho	In place (Draft, 1994)	In place (1989) Developing
Illinois	Developing	In place (1986) Developing
Indiana	In place (1991)	In place (1993)
Iowa	In place (1987) Developing	In place (1991) Developing
Kansas	In place (1993)	In place (1993)
Kentucky	In place (1993) Developing	In place (1993) Developing
Louisiana	In place (Draft, 1994) Developing	In place (1991) Developing
Maine	Developing	Developing
Maryland	In place (1985)	In place (1985)
Massachusetts	In place (Draft, 1994)	In place (Draft, 1994)
Michigan	In place (Draft, 1994)	In place (Draft, 1994)
Minnesota	In place (1991) Developing	In place (1991) Developing
Mississippi	In place (1993) Developing	In place (1991) Developing
Missouri	In place (1990) Developing	In place (1990) Developing

STATE	Mathematics Curriculum Framework	Science Curriculum Framework
Montana	Developing	In place (1991)
Nebraska	In place (1994)	In place (1994)
Nevada	In place (1994)	In place (1994)
New Hampshire	In place (Draft, 1994)	In place (Draft, 1994)
New Jersey	In place (Draft, 1993) Developing	In place (1990)
New Mexico	In place (1992)	In place (1992)
New York	In place (1994)	In place (1994)
North Carolina	In place (1989, 1992)	In place (1994)
North Dakota	In place (1993)	In place (1993)
Ohio	In place (1990)	In place (Draft, 1994) Developing
Oklahoma	In place (1993)	In place (1993)
Oregon	Developing	In place (1989) Developing
Pennsylvania	In place (1994)	In place (1990, 1995)
Puerto Rico		Developing
Rhode Island	Developing	Developing
South Carolina	In place (1993)	Developing
South Dakota	Developing	Developing
Tennessee	In place (1991)	In place (1990)
Texas	In place (1991) Developing	Developing
Utah	In place (1993)	In place (1992, 1994) Developing
Vermont	In place (Draft, 1994)	In place (Draft, 1994)
Virginia	In place (1988) Developing	In place (1988) Developing
Washington	In place (1985) Developing	In place (1985) Developing
West Virginia	In place (1991)	In place (1986, 1992)
Wisconsin	In place (1986) Developing	In place (1986) Developing
Wyoming	In place (1990)	In place (1990)

Source: Blank, R. & Pechman, E. (1995). Study of State Curriculum Frameworks in Mathematics and Science.

Notes: Developing = Developing a new framework document or revising a draft framework or one in place.

In this table, the term **framework** is used as a general category. The list includes documents titled state "frameworks," "content standards," and "curriculum guides."

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.2: State High School Graduation Requirements in Mathematics and Science (in Carnegie Course Units), 1995

STATE	Math	Science
Alabama	2	2
Advanced Diploma	3	3
Alaska	2	2
Arizona	2	2
Arkansas	3	3
California	2	2
Advanced Diploma	3	2
Colorado	LB	LB
Connecticut	3	2
Delaware	2	2
District of Columbia	3	3
Florida	3	3
Academic Scholars	4	4
Georgia	3	3
Advanced	3	3
Hawaii	2	2
Idaho	2	2
Illinois	2	1
Indiana	2	2
Academic Honors	4	4
Iowa	LB	LB
Kansas	2	2
Kentucky	3	2
Commonwealth Diploma	— 6 combined —	
Louisiana	3	3
Scholar Program/Regents	3	3
Maine	2	2
Maryland	3	3
Massachusetts	LB	LB
Michigan	LB	LB
Minnesota	1/LB	1/LB
Mississippi	3	2
Missouri	2	2
College Prepatory	3	3
Montana	2	2
Nebraska	LB	LB
Nevada	2	2
New Hampshire	2	2
New Jersey	3	2
New Mexico	3	2
New York	2	2
Regents Diploma	2	2
North Carolina	3	3
Scholars Program	4	4
North Dakota	2	2
Ohio	2	1
Oklahoma	2	2
College Prepatory	3	2
Oregon	2	2
Pennsylvania	3	3
Rhode Island	2	2
College Prepatory	3	2
South Carolina	3	2
Academic Achievement Honors	3	2
South Dakota	2	3
Tennessee	3	3
Honors Diploma	3	3
Texas	3	2
Advanced Program	3	3
Utah	2	2
Vermont	— 5 combined —	
Virginia	— 5 combined —	
Advanced Diploma	3	3
Washington	2	2
West Virginia	2	2
Wisconsin	2	2
Wyoming	LB	LB

Math
Regular Diploma
2.5 – 3 credits = 18 states
2 credits = 26 states
LB = (Local Board) 7 states

Science
Regular Diploma
2.5 – 3 credits = 12 states
2 credits = 30 states
1 credits = 2 states

Education Commission of the States (1993). Updated by CCSSO with State Math and Science Supervisors, January 1995.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.3 Students Taking First–Year Biology as a Percent of Students in Each High School Grade, 1994

	Biology, 1st Year			
STATE	% Grade 9	% Grade 10	% Grade 11	% Grade 12
Alabama	30	65	8	3
California	22	45	8	2
Connecticut	20	64	8	5
Idaho	6	85	10	8
Indiana	64	28	4	2
Kentucky	19	56	15	8
Missouri	24	33	20	23
New York	18	78	3	2
North Carolina	18	66	6	3
North Dakota	2	95	8	3
Ohio	28	52	10	6
Puerto Rico	0.1	66	15	3
Texas	36	51	9	3
Utah	21	56	16	8
Vermont	18	77	6	3
Washington	11	51	10	4
West Virginia	5	74	7	3
Wisconsin	26	74	10	3

Source: State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.4 Students Taking Algebra 1/Integrated Math 1 and Algebra 2/Integrated Math 3 as a Percent of Students in Each High School Grade, 1994

	Algebra 1/Integrated Math 1				Algebra 2/Integrated Math 3			
STATE	% Grade 8	% Grade 9	% Grade 10	% Grade 11–12	% Grade 9	% Grade 10	% Grade 11	% Grade 12
Alabama	13	39	16	7	1	14	31	9
California	21	42	23	7	5	11	23	5
Connecticut	22	43	18	10	2	15	32	12
Idaho	15	57	19	6	4	17	34	4
Indiana	6	65	9	3	1	19	29	2
Kentucky	14	27	23	30	5	17	22	22
Missouri	14	36	19	43	12	16	19	18
New York	11	55	10	1	0.2	7	37	4
North Carolina	25	27	24	14	1	16	25	15
North Dakota	7	78	18	7	2	21	47	12
Ohio	–	–	–	–	–	–	–	–
Puerto Rico	0	8	68	23	–	–	–	–
Texas	0	46	29	19	1	16	33	18
Utah	28	32	24	14	7	25	24	12
Vermont	16	47	21	8	1	16	28	10
Washington	0	36	20	9	3	16	23	9
West Virginia	21	32	18	12	2	17	21	8
Wisconsin	17	62	27	14	4	14	33	11

– Data not available

Source: State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.5: Grades 7–8 Mathematics Course Enrollments as a Percent of Students in Grades 7–8, 1994

			Grade 7					Grade 8	
STATE	Student Membership Grade 7	% Remedial Math 7	% Regular Math 7	% Accelerated Math 7	Student Membership Grade 8	% Remedial Math 8	% Regular Math 8	% Enriched Math 8	% Algebra 1 Math 8
Alabama	62,144	17	60	8	60,004	15	46	4	13
Alaska	9,852	7	59	22	9,160	5	45	21	15
Arizona	55,834	–	–	–	53,500	–	–	–	–
Arkansas	36,892	–	59	29	36,471	–	69	0	7
California	398,553	3	72	8	380,223	2	61	3	21
Colorado	49,168	–	–	–	47,665	–	–	–	–
Connecticut	36,127	8	65	24	34,662	5	44	27	22
Delaware	8,738	5	51	32	8,265	5	37	23	25
Dist. of Columbia	5,394	8	75	3	4,935	4	56	–	67
Florida	157,906	–	–	–	149,054	–	–	–	–
Georgia	99,401	–	–	–	97,354	–	–	–	–
Hawaii	13,608	–	91	–	13,245	–	81	29	0.30
Idaho	19,356	1	61	13	19,185	1	39	31	15
Illinois	136,363	–	–	–	138,518	–	–	–	–
Indiana	78,353	–	93	4	78,116	–	86	7	6
Iowa	38,861	–	–	–	38,548	–	–	–	–
Kansas	36,913	–	–	–	35,902	–	–	–	–
Kentucky	51,533	0.02	96	10	51,306	–	75	16	14
Louisiana	61,553	–	48	–	56,522	–	23	45	6
Maine	16,537	–	–	–	15,844	–	–	–	–
Maryland	58,407	–	–	–	55,285	–	–	–	–
Massachusetts	64,679	5	60	27	62,412	5	46	18	26
Michigan	119,423	–	–	–	116,702	–	–	–	–
Minnesota	64,539	–	33	–	63,105	–	25	–	8
Mississippi	42,696	–	88	26	39,815	1	65	–	12
Missouri	66,813	1	74	10	66,495	1	55	–	14
Montana	13,285	3	88	10	12,834	2	74	6	16
Nebraska	23,138	–	24	–	22,611	–	25	19	10
Nevada	18,419	11	58	23	17,825	14	38	29	8
New Hampshire	14,997	–	–	–	14,118	–	–	–	–
New Jersey	81,942	11	55	20	79,459	10	39	15	16
New Mexico	25,856	2	72	16	24,899	1	45	32	9
New York	194,988	16	81	13	188,274	16	77	0.40	11
North Carolina	86,428	3	69	22	86,093	3	70	22	25
North Dakota	9,729	3	89	11	9,329	3	61	27	7
Ohio	145,856	2	60	10	141,534	2	46	16	17
Oklahoma	47,724	–	73	11	46,153	–	38	31	9
Oregon	40,605	7	59	25	39,500	5	42	20	20
Pennsylvania	134,423	–	74	4	130,209	–	51	–	–
Puerto Rico	56,314	99	0	–	50,711	–	98	–	0
Rhode Island	11,136	–	–	–	10,650	–	–	–	–
South Carolina	53,043	–	–	–	50,591	–	–	–	–
South Dakota	11,604	–	–	–	11,427	–	–	–	–
Tennessee	67,705	–	90	–	64,124	76	0	–	–
Texas	286,548	–	–	–	274,208	–	–	–	–
Utah	37,528	7	56	47	38,031	4	26	33	38
Vermont	7,814	4	95	10	7,496	4	84	7	16
Virginia	80,496	–	–	–	78,443	–	–	–	–
Washington	73,106	–	–	–	70,666	–	–	–	–
West Virginia	25,657	4	70	26	25,677	2	48	21	21
Wisconsin	65,495	1	84	9	64,669	1	71	0	17
Wyoming	8,247	4	71	13	8,268	6	51	–	22
NATION	3,411,726	8	71	15	3,300,092	9	51	15	16

– Data not available

State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.6

High School Mathematics Course Enrollments, Level 1 Through 5, as a Percent of Students in Grades 9–12, 1994

STATE	Student Membership (Grades 9–12)	Algebra 1/ Integrated Math 1 (Level 1) % 9–12	Geometry/ Integrated Math 2 (Level 2) % 9–12	Algebra 2/ Integrated Math 3 (Level 3) % 9–12	Trigonometry Pre-Calculus (Level 4) % 9–12	Calculus (Level 5) % 9–12	Calculus AP (Level 5) % 9–12	Sum Formal Math % 9–12
Alabama	198,651	18	13	13	4	1	1	50
Alaska	32,347	18	13	12	5	2	–	51
Arizona	182,737	–	–	–	–	–	–	–
Arkansas	125,801	22	16	15	6	1	–	60
California	1,393,530	21	13	11	5	1	1	54
Colorado	164,260	–	–	–	–	–	–	–
Connecticut	127,655	19	17	15	9	2	1	64
Delaware	28,930	15	9	10	6	1	1	42
Dist. of Columbia	17,854	42	23	12	4	1	–	82
Florida	525,569	–	–	–	–	–	–	–
Georgia	324,879	–	–	–	–	–	–	–
Hawaii	48,728	17	12	8	6	0.1	1	43
Idaho	69,287	23	16	14	6	2	1	62
Illinois	503,024	–	–	–	–	–	–	–
Indiana	282,214	22	16	13	8	2	1	61
Iowa	142,601	24	19	16	9	3	–	71
Kansas	127,081	–	–	–	–	–	–	–
Kentucky	184,356	21	16	16	7		2	61
Louisiana	202,283	35	22	15	6	1	0.4	79
Maine	59,632	21	18	17	10	–	–	66
Maryland	197,072	–	–	–	–	–	–	–
Massachusetts	232,208	18	17	16	10	2	1	63
Michigan	423,081	18	15	11	5	1	–	50
Minnesota	233,253	21	18	16	10	3	–	68
Mississippi	131,112	22	16	16	10	0.5	1	65
Missouri	241,874	25	18	16	7	3	–	68
Montana	46,111	22	22	17	9	1	0.3	71
Nebraska	81,671	26	20	18	10	3	–	78
Nevada	60,727	23	13	11	6	1	0.2	54
New Hampshire	49,098	–	–	–	–	–	–	–
New Jersey	288,263	19	15	14	10	1	2	61
New Mexico	87,768	27	15	14	5	1	1	62
New York	743,933	20	16	12	6	1	2	55
North Carolina	305,060	18	19	13	10	1	1	62
North Dakota	35,000	27	22	20	13	1	–	82
Ohio	517,122	21	17	14	8	2	1	62
Oklahoma	162,511	23	16	15	5	1	1	61
Oregon	147,819	17	15	12	6	1	1	53
Pennsylvania	496,382	25	16	15	13	2	1	74
Puerto Rico	162,371	26	17	–	2	–	–	45
Rhode Island	38,470	–	–	–	–	–	–	–
South Carolina	176,745	–	–	–	–	–	–	–
South Dakota	39,971	–	–	–	–	–	–	–
Tennessee	236,542	21	15	15	4	1	–	57
Texas	927,209	27	17	15	8	1	0.3	68
Utah	137,235	28	23	22	10	1	3	87
Vermont	27,377	20	16	14	6	2	1	59
Virginia	278,009	–	–	–	–	–	–	–
Washington	255,528	18	15	13	5	2	1	53
West Virginia	96,264	16	15	12	7	1	1	52
Wisconsin	248,284	28	21	15	10	1	1	77
Wyoming	29,497	20	15	14	6	3	1	59
NATION	11,874,986	22	16	14	7	1	1	61

– Data not available

State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.7

High School Mathematics Course Enrollments, Review and Informal Math, as a Percent of Students in Grades 9–12, 1994

STATE	Student Membership (Grades 9–12)	General, Remedial (Level 1) % 9–12	Consumer, Vocational (Level 2) % 9–12	General (Level 3 & 4) % 9–12	Sum Review Math % 9–12	Pre-Algebra (Level 1) % 9–12	Basic Geometry (Level 2–3) % 9–12	Sum Informal Math % 9–12
Alabama	198,651	11	7	–	18	9	1	10
Alaska	32,347	3	4	–	7	12	–	12
Arizona	182,737	–	–	–	–	–	–	–
Arkansas	125,801	7	–	18	25	3	1	5
California	1,393,530	9	2	–	11	7	–	7
Colorado	164,260	–	–	–	–	–	–	–
Connecticut	127,655	5	4	3	12	11	7	18
Delaware	28,930	6	5	4	16	9	4	13
Dist. of Columbia	17,854	4	–	–	4	1	0.3	1
Florida	525,569	–	–	–	–	–	–	–
Georgia	324,879	–	–	–	–	–	–	–
Hawaii	48,728	9	17	0	26	11	2	13
Idaho	69,287	4	–	–	4	10	1	11
Illinois	503,024	–	–	–	–	–	–	–
Indiana	282,214	6	5	–	11	10	1	10
Iowa	142,601	6	6	5	16	7	–	7
Kansas	127,081	–	–	–	–	–	–	–
Kentucky	184,356	5	5	–	9	14	5	19
Louisiana	202,283	1	6	–	7	2	–	2
Maine	59,632	–	–	–	–	–	–	–
Maryland	197,072	–	–	–	–	–	–	–
Massachusetts	232,208	4	5	1	11	8	4	12
Michigan	423,081	4	–	–	4	8	–	8
Minnesota	233,253	7	3	–	10	–	–	–
Mississippi	131,112	5	5	–	11	12	–	12
Missouri	241,874	8	3	–	11	8	–	8
Montana	46,111	6	3	1	10	8	0	8
Nebraska	81,671	15	–	–	15	5	–	5
Nevada	60,727	2	13	–	16	12	1	13
New Hampshire	49,098	–	–	–	–	–	–	–
New Jersey	288,263	14	4	2	20	4	2	6
New Mexico	87,768	9	2	–	11	9	–	9
New York	743,933	14	3	0.4	17	11	3	14
North Carolina	305,060	3	2	0.5	6	18	–	18
North Dakota	35,000	2	2	–	4	7	–	7
Ohio	517,122	12	2	0	13	6	5	11
Oklahoma	162,511	6	2	–	7	10	1	11
Oregon	147,819	4	2	4	10	12	4	16
Pennsylvania	496,382	6	4	1	11	19	1	19
Puerto Rico	162,371	0	–	40	40	–	–	–
Rhode Island	38,470	–	–	–	–	–	–	–
South Carolina	176,745	–	–	–	–	–	–	–
South Dakota	39,971	–	–	–	–	–	–	–
Tennessee	236,542	1	4	2	7	0	1	1
Texas	927,209	1	1	–	2	13	6	19
Utah	137,235	3	2	1	6	18	1	19
Vermont	27,377	3	4	2	9	7	4	11
Virginia	278,009	–	–	–	–	–	–	–
Washington	255,528	7	1	–	8	10	–	10
West Virginia	96,264	5	7	3	15	14	1	15
Wisconsin	248,284	4	1	5	10	–	–	–
Wyoming	29,497	5	3	–	8	3	–	3
NATION	11,874,986	6	3	4	13	9	3	12

– Data not available.

State Departments of Education, Data on Public Schools, 1993–94, NCES, CCD Fall Membership 1993

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.8: Grades 7–8, Science Course Enrollments as a Percent of Students in Grades 7–8, 1994

STATE	Student Membership (Grades 7–8)	% General Science	% Life Science	% Earth Science	% Physical Science	% Integrated Science
Alabama	122,148	50	10	34	1	–
Alaska	19,012	43	15	5	11	10
Arizona	109,334	–	–	–	–	–
Arkansas	73,363	11	40	40	1	–
California	778,776	55	12	3	8	–
Colorado	96,833	–	–	–	–	–
Connecticut	70,789	29	29	9	21	8
Delaware	17,003	17	38	32	0	2
Dist. of Columbia	10,329	86	–	5	5	–
Florida	306,960	–	–	–	–	–
Georgia	196,755	–	–	–	–	–
Hawaii	26,853	1	33	21	–	12
Idaho	38,541	5	39	14	23	–
Illinois	274,881	–	–	–	–	–
Indiana	156,469	96	1	1	0.4	0.3
Iowa	77,409	–	–	–	–	–
Kansas	72,815	–	–	–	–	–
Kentucky	102,839	0.1	26	26	–	49
Louisiana	118,075	11	26	22	–	–
Maine	32,381	–	–	–	–	–
Maryland	113,692	–	–	–	–	–
Massachusetts	127,091	11	33	17	23	12
Michigan	236,125	–	–	–	–	–
Minnesota	127,644	–	24	21	9	–
Mississippi	82,511	92	–	–	–	3
Missouri	133,308	37	29	25	3	–
Montana	26,119	6	50	9	39	1
Nebraska	45,749	13	14	8	11	–
Nevada	36,244	24	6	4	29	1
New Hampshire	29,115	–	–	–	–	–
New Jersey	161,401	13	29	13	18	11
New Mexico	50,755	23	28	25	12	–
New York	383,262	13	39	12	25	–
North Carolina	172,521	–	0.04	0.04	1	109
North Dakota	19,058	–	51	48	–	–
Ohio	287,390	48	11	12	7	–
Oklahoma	93,877	7	–	20	4	54
Oregon	80,105	17	24	20	12	11
Pennsylvania	264,632	32	21	22	22	–
Puerto Rico	107,025	99	0	0	0	–
Rhode Island	21,786	–	–	–	–	–
South Carolina	103,634	–	–	–	–	–
South Dakota	23,031	–	–	–	–	–
Tennessee	131,829	11	–	–	–	–
Texas	560,756	–	–	–	–	–
Utah	75,559	–	58	28	42	0.4
Vermont	15,310	35	28	10	24	17
Virginia	158,939	–	–	–	–	–
Washington	143,772	–	–	–	–	–
West Virginia	51,334	5	8	10	2	64
Wisconsin	130,164	37	20	15	9	–
Wyoming	16,515	28	25	6	14	0.3
NATION	6,711,818	35	20	15	9	#

Note: – Data not available. Percentages may sum over 100%, indicating students reported for more than one subject.

# Too few states reporting data to impute national percent.

Source: State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.9: High School Biology and Chemistry Course Enrollments as a Percent of Students in Grades 9–12, 1994

STATE	Student Membership (Grades 9–12)	Biology 1st Year % 9–12	Biology 1st Year Applied % 9–12	Biology 2nd Year AP % 9–12	Biology 2nd Year Advanced % 9–12	Biology 2nd Year Other % 9–12	Chemistry 1st Year % 9–12	Chemistry 1st Year Applied % 9–12	Chemistry 2nd Year AP % 9–12	Chemistry 2nd Year Advanced % 9–12
Alabama	198,651	20	8	1	4	2	10	0.1	1	–
Alaska	32,347	20	2	1	0.3	1	8	1	0.4	0.3
Arizona	182,737	–	–	–	–	–	–	–	–	–
Arkansas	125,801	23	1	–	2	0.1	11	–	–	–
California	1,393,530	16	6	1	2	0.2	9	–	0.4	0.4
Colorado	164,260	–	–	–	–	–	–	–	–	–
Connecticut	127,655	15	11	1	5	1	12	3	0.4	0.4
Delaware	28,930	19	7	1	1	0.2	8	1	0.3	0.5
Dist. of Columbia	17,854	31	1	1	0.1	–	16	0.5	0	1
Florida	525,569	–	–	–	–	–	–	–	–	–
Georgia	324,879	–	–	–	–	–	–	–	–	
Hawaii	48,728	19	4	0.1	2	1	10	–	1	–
Idaho	69,287	27	1	–	2	0.3	10	–	–	–
Illinois	503,024	–	–	–	–	–	–	–	–	–
Indiana	282,214	17	10	1	3	2	9	3	1	2
Iowa	142,601	29	1	–	3	–	16	–	–	–
Kansas	127,081	–	–	–	–	–	–	–	–	–
Kentucky	184,356	26	–	1	6	1	14	–	0.4	1
Louisiana	202,283	26	–	0.3	2	–	13	–	0.2	0.2
Maine	59,632	22	–	–	–	–	16	–	–	–
Maryland	197,072	–	–	–	–	–	–	–	–	–
Massachusetts	232,208	18	6	1	3	2	13	2	0.5	0.5
Michigan	423,081	18	–	–	0	–	10		–	–
Minnesota	233,253	22	–	–	7	–	13			2
Mississippi	131,112	29	5	1	18	3	14	–	0.3	2
Missouri	241,874	24	1	–	9	1	12	–	–	2
Montana	46,111	25	2	0.3	5	1	13	0.5	0.1	1
Nebraska	81,671	25	7	–	9	–	14	–	–	–
Nevada	60,727	21	5	0.4	3	3	11	0.1	0.2	1
New Hampshire	49,098	–	–	–	–	–	–	–	–	–
New Jersey	288,263	15	8	1	2	1	12	2	1	0.4
New Mexico	87,768	25	1	1	2	–	9	–	1	–
New York	743,933	27	0.1	1	0.5	1	14	–	0.5	0.1
North Carolina	305,060	25	–	1	5	0.02	12	–	0.5	1
North Dakota	35,000	27	1	–	9	2	17	–	–	1
Ohio	517,122	25	3	1	2	0	13	–	0.5	–
Oklahoma	162,511	24	1	1	8	2	9	0.3	0.4	1
Oregon	147819	20	2	1	1	1	10	1	0.4	1
Pennsylvania	496,382	23	6	1	4	–	14	–	1	2
Puerto Rico	162,371	23	0	–	–	–	15	0	–	–
Rhode Island	38,470	–	–	–	–	–	–	–	–	–
South Carolina	176,745	–	–	–	–	–	–	–	–	–
South Dakota	39,971	–	–	–	–	–	–	–	–	–
Tennessee	236,542	23	0	1	2	4	12	–	0.3	0.3
Texas	927,209	26	2	–	3	0.0	11	–	0.1	1
Utah	137,235	30	7	2	3	5	10	2	2	1
Vermont	27,377	21	6	1	2	1	13	3	1	1
Virginia	278,009	–	–	–	–	–	–	–	–	–
Washington	255,528	18	2	1	2	2	9	–	0.3	1
West Virginia	96,264	23	0.2	1	6	1	10	2	1	1
Wisconsin	248,284	28	1	1	4	0.3	14	2	0.4	2
Wyoming	29,497	20	0.3	0.3	4	–	8	0.2	0.1	1
NATION	11,874,986	23	3	1	4	1	12	#	0.5	1

– Data not available. # Too few states reporting data to impute national percent

State Departments of Education, Data on Public Schools, 1993–94, NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.10: **High School Physics and Earth Science Course Enrollments as a Percent of Students in Grades 9–12, 1994**

STATE	Student Membership (Grades 9–12)	Physics 1st Year % 9–12	Physics 1st Year Applied % 9–12	Physics 2nd Year AP % 9–12	Physics 2nd Year Advanced % 9–12	Earth Science 1st Year % 9–12	Earth Science 1st Year Applied % 9–12	Earth Science 2nd Year % 9–12
Alabama	198,651	3	0.03	0.3	–	0.1	–	0
Alaska	32,347	3	0.4	0.1	0.03	6	0.05	0.3
Arizona	182,737	–	–	–	–	–	–	–
Arkansas	125,801	3	1	–	–	2	–	0
California	1,393,530	4	0.04	0.4	0.2	2	–	1
Colorado	164,260	–	–	–	–	–	–	–
Connecticut	127,655	5	3	0.3	0.3	8	1	2
Delaware	28,930	3	1	0.1	0.03	5	1	–
Dist. of Columbia	17,854	4	–	0.1	–	3	–	1
Florida	525,569	–	–	–	–	–	–	–
Georgia	324,879	–	–	–	–	–	–	–
Hawaii	48,728	3	2	0.2	–	7	–	0.2
Idaho	69,287	3	–	–	–	16	–	1
Illinois	503,024	–	–	–	–	–	–	–
Indiana	282,214	3	2	1	0.2	5	2	1
Iowa	142,601	8	–	–	–	8	–	0.3
Kansas	127,081	–	–	–	–	–	–	–
Kentucky	184,356	4	–	0.2	0.2	1	–	–
Louisiana	202,283	5	–	0.2	0.04	4	–	0.0
Maine	59,632	12	–	–	–	14	–	–
Maryland	197,072	–	–	–	–	–	–	–
Massachusetts	232,208	6	1	0.3	0.2	6	2	1
Michigan	423,081	5	–	–	–	5	–	–
Minnesota	233,253	6	0.1	–	1	2	0.3	0.3
Mississippi	131,112	4	–	0.2	0.1	–	–	0.3
Missouri	241,874	4	–	–	0.4	3	–	1
Montana	46,111	6	0.1	0	0.5	21	0.1	0.1
Nebraska	81,671	7	1	–	–	10	–	–
Nevada	60,727	3	1	–	0.1	13	–	–
New Hampshire	49,098	–	–	–	–	–	–	–
New Jersey	288,263	6	0.4	0.4	0.4	7	1	0.4
New Mexico	87,768	3	0.4	0.4	–	1	–	1
New York	743,933	6	–	1	0.02	16	–	2
North Carolina	305,060	3	–	0.1	0.1	5	–	1
North Dakota	350,00	7	0.3	–	–	0.1	–	1
Ohio	517,122	5	–	0.4	–	5	–	1
Oklahoma	162,511	2	1	0.3	0.1	1	–	0.2
Oregon	147,819	4	1	0.3	1	3	0.4	0.2
Pennsylvania	496,382	7	–	0.4	1	6	–	2
Puerto Rico	162,371	7	–	–	–	9	–	–
Rhode Island	38,470	–	–	–	–	–	–	–
South Carolina	176,745	–	–	–	–	–	–	–
South Dakota	39,971	–	–	–	–	–	–	–
Tennessee	236,542	4	–	0.2	–	2	–	0.2
Texas	927,209	3	0	0.04	0.2	0	–	3
Utah	137,235	5	2	1	0.2	15	0.4	0.1
Vermont	27,377	7	2	0.2	0.2	12	1	0.2
Virginia	278,009	–	–	–	–	–	–	–
Washington	255,528	4	–	0.1	0.4	3	–	0.3
West Virginia	96,264	3	1	0.1	0.03	1	–	0.4
Wisconsin	248,284	6	1	0.2	1	5	–	1
Wyoming	29,497	3	1	–	–	9	2	–
NATION	11,874,986	5	#	0.3	0.3	5	#	1

– Data not available. # Too few states reporting data to impute national percent.

State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.11: High School General, Physical, Integrated, Environmental, and Other Science Course Enrollments, and Computer Science Course Enrollments, as a Percent of Students in Grades 9–12, 1994

STATE	Student Membership (Grades 9–12)	General Science % 9–12	Physical Science % 9–12	Integrated Science % 9–12	Environ. Science % 9–12	Other Science % 9–12	Computer Science Prog. I % 9–12	Advanced Comp. Sci./ Prog. II % 9–12	Comp. Sci. Advanced Placement % 9–12	Comp. Sci./ Comp. Prog. % 7–8
Alabama	198,651	2	23	–	–	0.03	2	–	–	0.2
Alaska	32,347	9	7	0.4	1	4	–	–	–	–
Arizona	182,737	–	–	–	–	–	–	–	–	–
Arkansas	125,801	5	25	–	–	3	3	–	–	1
California	1,393,530	3	10	–	0.4	6	1	–	0.1	7
Colorado	164,260	–	–	–	–	–	–	–	–	–
Connecticut	127,655	8	7	0.5	1	1	1	0.2	0.1	3
Delaware	28,930	1	11	1	0	2	3	1	0.2	12
Dist. of Columbia	17,854	13	–	–	–	1	8	1	–	14
Florida	525,569	–	–	–	–	–	–	–	–	–
Georgia	324,879	–	–	–	–	–	–	–	–	–
Hawaii	48,728	4	17	0.4	1	3	2	0.1	0.1	6
Idaho	69,287	1	10	–	1	0	6	1	1	10
Illinois	503,024	–	–	–	–	–	–	–	–	–
Indiana	282,214	4	8	1	2	0.03	2	0.2	–	0.3
Iowa	142,601	9	12	–	3	0.3	1	0.2	–	–
Kansas	127,081	–	–	–	–	–	–	–	–	–
Kentucky	184,356	–	12	11	–	2	1	0.1	0.3	12
Louisiana	202,283	6	23	–	8	0.5	2	0.2	0.1	0.3
Maine	59,632	–	16	–	–	–	–	–	–	–
Maryland	197,072	–	–	–	–	–	–	–	–	–
Massachusetts	232,208	3	8	1	2	4	5	1	0.2	3
Michigan	423,081	7	7	1	2	2	9	–	–	–
Minnesota	233,253	–	9	0.3	2	–	2	–	–	–
Mississippi	131,112	7	–	–	–	0.1	3	0.4	0.05	–
Missouri	241,874	5	19	–	2	1	2	1	–	1
Montana	46,111	1	2	1	1	0.2	1	1	0.03	1
Nebraska	81,671	7	14	–	–	5	15	2	–	15
Nevada	60,727	3	3	0.01	3	2	4	1	0.04	1
New Hampshire	49,098	–	–	–	–	–	–	–	–	–
New Jersey	288,263	3	8	1	2	2	–	–	–	–
New Mexico	87,768	5	13	–	1	1	2	–	0.3	2
New York	743,933	3	6	1	2	4	3	–	0.3	16
North Carolina	305,060	–	22	–	0	2	7	–	0.1	3
North Dakota	35,000	–	30	–	–	1	2	1	–	–
Ohio	517,122	11	7	–	0	0.1	7	–	0.2	16
Oklahoma	162,511	3	19	–	1	3	3	1	0.2	–
Oregon	147,819	5	11	3	2	5	5	1	0.3	22
Pennsylvania	496,382	6	10	–	6	2	7	1	0.2	–
Puerto Rico	162,371	21	0.3	–	–	–	–	–	–	–
Rhode Island	38,470	–	–	–	–	–	–	–	–	–
South Carolina	176,745	–	–	–	–	–	–	–	–	–
South Dakota	39,971	–	–	–	–	–	–	–	–	–
Tennessee	236,542	21	0	–	1	1	0.4	0	0.1	–
Texas	927,209	–	21	0	1	0.3	1	0.0	–	–
Utah	137,235	–	12	–	1	2	3	0.4	0.4	3
Vermont	27,377	4	6	0.4	4	2	2	0.5	0.1	9
Virginia	278,009	–	–	–	–	–	–	–	–	–
Washington	255,528	5	9	–	1	2	2	0.3	0	–
West Virginia	96,264	2	13	12	2	4	3	0.4	0.1	6
Wisconsin	248,284	6	14	–	–	5	8	3	0.1	21
Wyoming	29,497	5	7	1	–	3	6	2	0.2	14
NATION	11,874,986	6	13	#	2	2	3	#	#	#

– Data not available # Too few states reporting data to impute national percent.

Source: State Departments of Education, Data on Public Schools, 1993–94; NCES, CCD Fall Membership 1993.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.12: Instructional Emphasis Grade 8 Teachers Place on Numbers/Operations and Measurement

STATE	Average Numbers/Operations and Measurement % of Students	Heavy Emphasis on Numbers/Operations % of Students	Heavy Emphasis on Measurement % of Students
Mississippi	58	86	30
Guam	56	86	25
South Carolina	55	70	40
Alabama	55	79	30
Georgia	54	80	28
Tennessee	52	81	23
Oklahoma	50	82	17
Kentucky	49	77	20
West Virginia	48	83	12
Arizona	47	79	15
Arkansas	47	78	15
Louisiana	47	81	12
Texas	47	70	23
NATION	46	76	16
Florida	46	76	15
Massachusetts	46	77	14
Utah	46	82	9
Indiana	45	80	10
Ohio	45	76	14
New Mexico	44	75	13
North Dakota	44	73	15
Maine	44	67	20
Minnesota	44	74	13
North Carolina	43	72	14
Virginia	43	79	6
Delaware	42	71	13
Iowa	42	73	11
New Jersey	42	65	19
Michigan	42	63	20
Pennsylvania	42	72	11
California	41	67	14
New Hampshire	41	71	10
Wyoming	41	73	8
Connecticut	40	64	16
New York	40	72	8
Virgin Islands	40	71	9
Wisconsin	40	66	14
Colorado	40	69	10
Idaho	40	69	10
Missouri	40	68	11
Nebraska	39	71	7
Dist. of Columbia	39	59	18
Rhode Island	39	65	12
Hawaii	38	64	12
Maryland	36	57	15

Source: National Center for Education Statistics (1993c). Data Compendium for the NAEP 1992 Mathematics Assessment

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix C.13: **Instructional Emphasis Grade 8 Teachers Place on Geometry and Algebra/ Functions**

STATE	Average Geometry and Algebra/Functions % of Students	Heavy Emphasis Geometry % of Students	Heavy Emphasis Algebra/Functions % of Students
Louisiana	44	15	72
Texas	44	30	57
New York	42	35	48
New Jersey	40	32	47
Dist. of Columbia	39	24	54
Iowa	38	21	55
South Carolina	38	40	36
Missouri	38	32	43
Alabama	36	30	42
Kentucky	36	22	50
Maryland	36	20	51
Tennessee	36	29	42
New Mexico	35	21	49
North Dakota	35	16	54
Wisconsin	35	22	48
Mississippi	35	25	44
Georgia	34	24	44
Michigan	34	21	47
Colorado	34	14	53
Utah	34	8	59
Idaho	33	12	54
Maine	33	20	46
Massachusetts	33	19	47
Pennsylvania	33	18	48
Arizona	32	14	50
Minnesota	32	10	54
NATION	32	18	46
Virginia	32	12	52
Wyoming	31	15	47
Delaware	31	20	41
Oklahoma	31	12	49
Rhode Island	31	16	45
Florida	30	13	47
New Hampshire	30	18	42
California	29	16	42
Connecticut	29	18	40
Indiana	29	14	44
North Carolina	29	14	44
Nebraska	29	12	45
Ohio	29	19	38
West Virginia	28	10	46
Arkansas	25	14	35
Guam	24	20	28
Hawaii	24	16	31
Virgin Islands	14	2	25

National Center for Education Statistics (1993c). Data Compendium for the NAEP 1992 Mathematics Assessment

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

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Characteristics of Science and Mathematics Teachers

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Appendix D.1: **Secondary Teachers: State Certification Requirements in Science and Mathematics, 1994**

	Credits Required in Certification Field				
STATE	**Math**	**Broad Field Science**	**Biology Chemistry Physics Earth Science**	**Methods of Teaching Math & Science Required**	**State Certification Other Than by Credits**
Alabama	39	60	27	–	IHE
Alaska	–	–	–	–	IHE
Arizona	30	30	30	yes	–
Arkansas	21	–	24	yes	–
California	–	–	IHE (biological/physical)	–	IHE
Colorado	–	–	–	–	IHE
Connecticut	30	–	30	–	IHE
Delaware	36	–	42 (b, es) 45 (c, p)	yes	State approved program
Dist. of Columbia	33	–	30	yes	–
Florida	30	–	21	yes	–
Georgia	60 qtr.	70 qtr.	40 qtr.	–	State approved program
Hawaii	–	–	–	yes	IHE
Idaho	20	20	20	yes	–
Illinois	25	24	24	yes	–
Indiana	36	–	36	yes	–
Iowa	24	24	24	yes	–
Kansas	–	–	–	–	Competency–based standards
Kentucky	48	48	21–30	yes	IHE
Louisiana	20	–	20	–	–
Maine	36	–	36 (life, physical)	yes	–
Maryland	30	–	45	yes	–
Massachusetts	major	major	major	yes	Defined standards
Michigan	30/20	30/20	30/20	–	Approved program
Minnesota	–	–	IHE (biology/physical)	yes	IHE
Mississippi	–	–	–	–	IHE
Missouri	30	30	20	yes	–
Montana	30/20	40	30/20	–	IHE
Nebraska	30	56	24	yes	–
Nevada	30/16	36/24	30/16	yes	–
New Hampshire	–	–	–	–	IHE
New Jersey	30	–	30	–	Professional education (methods)
New Jersey	24–30	24–30	–	yes	IHE
New York	36	–	18	–	Outcome–based program
North Carolina	–	–	–	–	IHE/Competency–based
North Dakota	–	–	–	yes	–
Ohio	30	60	30	–	Program standards (methods)
Oklahoma	40	–	40	yes	–
Oregon	42/21	45	45 (b, es) 27 (c, p)	yes	–
Pennsylvania	–	–	–	–	Approval based on competencies
Rhode Island	30	30	30	yes	State approved program
South Carolina	30	30	12	yes	State approved program
South Dakota	18	21	12 (b, c, p) 18 (es)	–	–
Tennessee	36 qtr.	48 qtr.	24 qtr.	–	State approved program
Texas	24	48	24	yes	–
Utah	45 qtr.	–	69 qtr. (b, es) 45 qtr. (c, p)	yes	–
Vermont	–	–	–	–	Competency–based program
Virginia	36	–	32 (b, c, p) 36 (es)	–	–
Washington	24 qtr.	45 qtr.	24 qtr.	yes	–
West Virginia	–	–	–	–	IHE
Wisconsin	34	54	34	yes	IHE
Wyoming	–	–	–	–	IHE
TOTAL	36	22	35	28	29

– No State Requirement; 30/20 (e.g., Michigan, Math) = major/minor; IHE = State-approved program of institutions of higher education.
"Credits" = Semester credits, unless quarter credits specified.

State Departments of Education, CCSSO Policies and Practices Survey, January 1994. Reviewed by state science and mathematics supervisors, January, 1995.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.2: Middle Grade Teachers: State Certification Requirements in Science and Mathematics, 1994

STATE	Separate Middle Grade Certification	Course Credits Required Math	Course Credits Required Science	Methods of Teaching Math & Science Required	State Certification Other Than by Credits
Alabama	yes	27	60	–	IHE
Alaska	yes	–	–	–	IHE
Arizona	yes	add 2 courses		yes	–
Arkansas	yes	18	18	yes	–
California	yes	–	–	–	IHE
Colorado	yes	–	–	–	IHE
Connecticut	yes	3	3	–	IHE
Delaware	yes	24	39	yes	State approved program
Dist. of Columbia	yes	6	6	yes	–
Florida	yes	18	18	yes	–
Georgia	yes	–	–	–	State approved program
Hawaii	no	–	–	–	–
Idaho	no	–	–	–	–
Illinois	yes	6	12	yes	–
Indiana	yes	18	18	yes	–
Iowa	no	–	–	–	–
Kansas	yes	–	–	–	Competency–based standards
Kentucky	yes	24	24	yes	–
Louisiana	yes	12	16	–	–
Maine	yes	18	18	–	–
Maryland	no	–	–	–	–
Massachusetts	yes	major	major	yes	Defined standards
Michigan	yes	–	–	–	Middle school endorsement (18 cr.)
Minnesota	yes	–	–	–	IHE
Mississippi	no	–	–	–	–
Missouri	yes	21	21	yes	–
Montana	no	–	–	–	–
Nebraska	yes	15	30	–	IHE
Nevada	no	–			
New Hampshire	yes	–	–	–	IHE
New Jersey	no	–	–	–	–
New Mexico	no	–	–	–	–
New York	yes	36	18	–	Outcome–based program
North Carolina	yes	–	–	–	IHE/Competency–based
North Dakota	yes	–	–	yes	IHE
Ohio	yes	20	20	–	Program standards cover methods
Oklahoma	yes	18	18	–	–
Oregon	no	–	–	–	–
Pennsylvania	no	–	–	–	–
Rhode Island	yes	18	18	yes	State approved program
South Carolina	yes	–	12	yes	–
South Dakota	yes	12	12	–	–
Tennessee	no	–	–	–	State Board approved program
Texas	no	–	–	–	–
Utah	no	–	–	–	–
Vermont	yes	18 hours	18 hours	–	Transcript analysis
Virgina	yes	18	18	–	–
Washington	no	–	–	–	–
West Virginia	no				–
Wisconsin	yes	22	22	yes	IHE
Wyoming	no	–	–	–	–
TOTAL	34	23	24	14	21

– No State Requirement

IHE = State-approved program of institutions of higher education

Credits = Semester credits, unless quarter credits specified

State Departments of Education, CCSSO Policies and Practices Survey, January 1994; reviewed by state mathematics and science supervisors, January, 1995

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

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Appendix D.3: Mathematics Teachers in Grades 9–12 by Time Assigned by Certification Status, 1994

		Mathematics Assignment		Certification			
				Main Assignment		2nd or 3rd Assignment	
STATE	Total Math Teachers	Main %	2nd or 3rd %	% Certified	% Not Certified	% Certified	% Not Certified
Alabama	1,670	48	52	48	0.1	50	2
Alaska	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–
Arkansas	687 *	–	–	–	–	–	–
California	9,301	71	29	65	6	17	12
Colorado	1,319	89	11	74	15	3	8
Connecticut	1,529	83	17	83	0.3	16	1
Delaware	200 *	–	–	91	10	–	–
Dist. of Columbia	306	100	0	100	0	0	0
Florida	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–
Hawaii	560	62	38	53	9	21	17
Idaho	764	50	50	49	1	46	4
Illinois	4,013	92	8	88	4	8	0.4
Indiana	2,335	87	13	86	2	11	2
Iowa	1,495	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–
Kentucky	1,606	87	13	87	1	12	1
Louisiana	1,472	95	5	89	7	3	2
Maine	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–
Massachusetts	2,519	84	16	81	4	10	6
Michigan	–	–	–	–	–	–	–
Minnesota	1,810	79	21	78	1	19	2
Mississippi	1,133	84	16	79	6	12	3
Missouri	2,109	85	15	84	1	14	1
Montana	520	84	16	83	1	12	4
Nebraska	1,241	86	14	82	4	6	8
Nevada	576	71	29	69	2	27	2
New Hampshire	476	–	–	–	–	–	–
New Jersey	4,180	80	20	80	0	20	0
New Mexico	755	78	22	75	3	18	5
New York	7,823	74	26	71	3	21	4
North Carolina	4,263	47	53	45	1	43	10
North Dakota	470	67	33	67	0	33	0
Ohio	4,756	74	26	74	1	21	5
Oklahoma	1,792	92	8	88	4	6	2
Oregon	1,167	86	14	–	–	–	–
Pennsylvania	6,431 **	96	4	87	9	3	1
Puerto Rico	1,712	66	34	56	10	34	0.4
Rhode Island	416	96	4	96	0	4	0
South Carolina	–	–	–	–	–	–	–
South Dakota	484	84	16	82	1	14	2
Tennessee	1,909	84	16	81	0.2	9	1
Texas	11,215	73	27	61	12	13	14
Utah	1,321	69	31	64	5	26	5
Vermont	274	78	22	–	–	–	–
Virginia	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–
West Virginia	1,205	70	30	–	–	–	–
Wisconsin	2,010	88	12	88	0	12	0
Wyoming	275	85	15	80	5	12	2
NATION	116,530	77	23	71	5	17	6

– Data not available; Main Assignment = Half time or more assigned to subject; 2nd or 3rd Assignment = Less than half time assigned to subject; * = Main assignment only; ** = grades 7–12. National totals include imputation for nonreporting states.

Several state percentages include teachers with general secondary certification: Alabama – 16; California – 1,215; Connecticut – 98; Hawaii – 162; Illinois – 3,839; Kentucky – 46; Massachusetts – 64.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.4: Biology Teachers in Grades 9–12 by Time Assigned by Certification Status, 1994

STATE	Total Biology Teachers	Biology Assignment: Main %	Biology Assignment: 2nd or 3rd %	Certification, Main Assignment: % Certified	Certification, Main Assignment: % Certified Broad Field	Certification, Main Assignment: % Not Certified	Certification, 2nd or 3rd Assignment: % Certified	Certification, 2nd or 3rd Assignment: % Certified Broad Field	Certification, 2nd or 3rd Assignment: % Not Certified
Alabama	884	19	81	15	3	0	60	20	1
Alaska	—	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—	—
Arkansas	636	43	57	39	3	1	48	6	3
California	3,663	58	42	47	7	5	27	5	9
Colorado	1,157 ***	92	8	0	90	2	0	3	5
Connecticut	709	62	38	61	0.3	0.1	34	2	2
Delaware	64 *		—	80	13	8	—	—	—
Dist. of Columbia	92	100	0	100	0	0	0	0	0
Florida	—	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—	—
Hawaii	187	53	47	30	16	7	13	22	12
Idaho	278	53	47	36	17	0	23	23	2
Illinois	1,604	81	19	0	77	4	0	18	1
Indiana	1,061	74	26	73	0	2	23	0	2
Iowa	732	—	—	—	—	—	—	—	—
Kansas	—	—	—	—	—	—	—	—	—
Kentucky	752	70	30	70	0	0.4	28	0	2
Louisiana	571	83	17	74	0	9	12	0	5
Maine	—	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—	—
Massachusetts	1,031	76	24	71	3	2	15	4	5
Michigan	—	—	—	—	—	—	—	—	—
Minnesota	795	66	34	53	11	2	26	6	3
Mississippi	813	68	32	58	0	10	21	0	11
Missouri	1,089	70	30	69	0	1	27	0	3
Montana	267	49	51	5	44	0	2	48	1
Nebraska	598	60	40	57	0	3	34	0	6
Nevada	249	57	43	10	47	0.4	9	32	1
New Hampshire	182	—	—	—	—	—	—	—	—
New Jersey	1,261	81	19	81	0	0	19	0	0
New Mexico	363	59	41	0	56	3	0	36	5
New York	5,348	68	32	65	0	3	27	0	5
North Carolina	1,289	54	46	21	32	1	11	27	8
North Dakota	269	33	67	28	5	0	46	20	0
Ohio	1,932	64	36	51	9	4	22	7	7
Oklahoma	983	69	31	68	0	1	30	0	1
Oregon	382	81	19	—	—	—	—	—	—
Pennsylvania	1,976 **	87	13	68	14	5	8	4	1
Puerto Rico	80	93	8	91	0	1	8	0	0
Rhode Island	173	82	18	82	0	0	18	0	0
South Carolina	—	—	—	—	—	—	—	—	—
South Dakota	255	69	31	55	13	2	26	2	2
Tennessee	771	64	36	64	0	0.3	31	0	1
Texas	7,622	58	42	51	0	7	24	0	18
Utah	502	69	31	64	0	5	25	0	6
Vermont	110	66	34	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—
West Virginia	456	68	32	—	—	—	—	—	—
Wisconsin	914	79	21	79	0	0	21	0	0
Wyoming	147	76	24	53	19	4	22	1	0
NATION	54,413	64	36	53	8	4	24	5	8

— Data not available; Main Assignment = Half time or more assigned to subject. 2nd or 3rd Assignment = Less than half time assigned to subject.

* = Main assignment only; ** = grades 7–12; *** = All science. National totals include imputation for nonreporting states.

General secondary certification included in broad field category: Alabama – 2; California – 433; Connecticut – 18; Hawaii – 70; Illinois – 1,523; Massachusetts – 18; Ohio – 25.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.5: **Chemistry Teachers in Grades 9–12 by Time Assigned by Certification Status, 1994**

		Chemistry Assignment		Certification					
				Main Assignment			2nd or 3rd Assignment		
STATE	Total Chemistry Teachers	Main %	2nd or 3rd %	% Certified	% Certified Broad Field	% Not Certified	% Certified	% Certified Broad Field	% Not Certified
Alabama	393	6	94	3	3	0	40	48	6
Alaska	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–
Arkansas	330	32	68	23	8	1	32	32	5
California	1,532	54	46	41	6	7	32	5	8
Colorado	–	–	–	–	–	–	–	–	–
Connecticut	398	54	46	53	0.3	1	40	2	4
Delaware	22 *	–	–	86	9	5	–	–	–
Dist. of Columbia	45	100	0	100	0	0	0	0	0
Florida	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–
Hawaii	65	63	37	14	35	14	5	32	0
Idaho	134	29	71	15	13	1	18	32	21
Illinois	1,075	67	33	0	63	4	0	31	2
Indiana	558	73	27	71	0	1	25	0	2
Iowa	425	–	–	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–	–	–
Kentucky	399	63	37	63	0	0	35	0	1
Louisiana	216	73	27	66	0	7	19	0	8
Maine	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–
Massachusetts	635	79	21	72	5	2	12	8	2
Michigan	–	–	–	–	–	–	–	–	–
Minnesota	511	49	51	31	14	4	30	11	10
Mississippi	332	54	46	41	0	13	27	0	19
Missouri	605	46	54	45	0	0.3	50	0	4
Montana	162	32	68	22	10	0	22	44	2
Nebraska	311	28	72	25	0	3	51	0	21
Nevada	89	66	34	22	44	0	2	31	0
New Hampshire	69	–	–	–	–	–	–	–	–
New Jersey	745	76	24	76	0	0	24	0	0
New Mexico	146	47	53	0	44	3	0	44	9
New York	1,919	67	33	64	0	2	28	0	5
North Carolina	593	56	44	13	42	1	8	33	3
North Dakota	177	16	84	10	6	0	28	55	0
Ohio	1,063	57	43	34	21	2	21	18	4
Oklahoma	494	32	68	32	0	0.2	66	0	2
Oregon	–	–	–	–	–	–	–	–	–
Pennsylvania	1,098 **	86	14	58	22	6	6	8	1
Puerto Rico	279	85	15	83	0	2	15	0	0
Rhode Island	93	82	18	78	3	0	17	1	0
South Carolina	–	–	–	–	–	–	–	–	–
South Dakota	159	60	40	36	21	3	29	8	4
Tennessee	407	56	44	61	0	0.2	35	0	3
Texas	1,878	54	46	49	0	5	37	0	10
Utah	139	67	33	58	0	9	25	0	8
Vermont	77	60	40	–	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–
West Virginia	185	62	38	–	–	–	–	–	–
Wisconsin	559	62	38	62	0	0	38	0	0
Wyoming	88	67	33	48	15	5	26	6	1
NATION	23,894	57	43	44	10	3	28	10	5

– Data not available. Main Assignment = Half time or more assigned to subject. 2nd or 3rd Assignment = Less than half time assigned to subject. * = Main assignment only. ** = Grades 7–12. National totals include imputation for nonreporting states.

General secondary certification included in broad field category: California = 177; Connecticut = 9; Hawaii = 44; Illinois = 1,016; Massachusetts = 12; Ohio = 18; Rhode Island = 1.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.6: **Physics Teachers in Grades 9–12 by Time Assigned by Certification Status, 1994**

		Physics Assignment		Certification					
				Main Assignment			2nd or 3rd Assignment		
STATE	Total Physics Teachers	Main %	2nd or 3rd %	% Certified	% Certified Broad Field	% Not Certified	% Certified	% Certified Broad Field	% Not Certified
Alabama	286	1	99	0	0.3	0.3	16	72	12
Alaska	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–
Arkansas	247	3	97	2	1	0	30	53	14
California	981	30	70	23	2	5	54	7	9
Colorado	–	–	–	–	–	–	–	–	–
Connecticut	267	42	58	36	4	2	43	6	9
Delaware	29 *	–	–	59	31	10	–	–	–
Dist. of Columbia	21	100	0	100	0	0	0	0	0
Florida	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–
Hawaii	49	39	61	6	31	2	10	39	12
Idaho	97	10	90	6	2	2	9	59	22
Illinois	685	46	54	0	44	2	0	52	
Indiana	384	32	68	28	0	3	57	0	12
Iowa	375	–	–	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–	–	–
Kentucky	226	15	85	15	0	0	68	0	17
Louisiana	95	48	52	38	0	11	32	0	20
Maine	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–
Massachusetts	417	65	35	58	6	1	20	13	2
Michigan	–	–	–	–	–	–	–	–	–
Minnesota	370	32	68	23	7	1	41	17	10
Mississippi	208	9	91	6	0	3	47	0	44
Missouri	377	18	82	17	0	1	64	0	18
Montana	141	13	87	9	5	0	15	69	3
Nebraska	275	14	86	12	0	2	58	0	28
Nevada	53	36	64	13	23	0	13	45	6
New Hampshire	37	–	–	–	–	–	–	–	–
New Jersey	340	71	29	71	0	0	29	0	0
New Mexico	92	18	82	0	18	0	0	72	10
New York	1,160	54	46	52	0	1	35	0	10
North Carolina	330	18	82	5	13	1	12	59	10
North Dakota	133	6	94	2	5	0	11	83	0
Ohio	769	27	73	15	10	2	31	37	5
Oklahoma	287	13	87	11	0	2	69	0	18
Oregon	–	–	–	–	–	–	–	–	–
Pennsylvania	702 **	73	27	38	31	4	9	15	3
Puerto Rico	159	75	25	69	0	6	25	0	0
Rhode Island	63	75	25	65	10	0	24	2	0
South Carolina	–	–	–	–	–	–	–	–	–
South Dakota	131	54	46	37	11	5	28	12	5
Tennessee	235	11	89	13	0	0.4	75	0	11
Texas	1,069	24	76	23	0	2	57	0	19
Utah	85	45	55	41	0	4	44	0	12
Vermont	49	59	41	–	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–
West Virginia	126	23	77	–	–	–	–	–	–
Wisconsin	399	34	66	34	0	0	66	0	0
Wyoming	71	61	39	42	13	6	37	1	1
NATION	15,257	33	67	24	7	2	38	17	11

– Data not available; Main Assignment = Half time or more assigned to subject. 2nd or 3rd Assignment = Less than half time assigned to subject. * = Main assignment only; ** = Grades 7–12. National totals include imputation for nonreporting states.

General secondary certification included in broad field category: California – 94, Connecticut – 27, Hawaii – 34, Illinois – 659, Massachusetts – 8, Ohio – 17.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.7: **Earth Science Teachers in Grades 9–12 by Time Assigned by Certification Status, 1994**

		Earth Science Assignment		Certification					
				Main Assignment			2nd or 3rd Assignment		
STATE	Total Earth Science Teachers	Main %	2nd or 3rd %	% Certified	% Certified Broad Field	% Not Certified	% Certified	% Certified Broad Field	% Not Certified
Alabama	24	0	100	0	0	0	0	100	0
Alaska	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–
Arkansas	54	39	61	28	4	7	50	0	11
California	585	32	68	26	3	3	49	7	11
Colorado	–	–	–	–	–	–	–	–	–
Connecticut	260	51	49	48	0	3	29	3	17
Delaware	8 *	–	–	88	13	0	–	–	–
Dist. of Columbia	0	–	–	–	–	–	–	–	–
Florida	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–
Hawaii	74	34	66	0	30	4	0	53	14
Idaho	165	39	61	8	30	1	9	48	4
Illinois	315	58	42	0	54	4	0	40	1
Indiana	278	62	38	52	0	10	22	0	16
Iowa	226	–	–	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–	–	–
Kentucky	40	13	88	8	0	5	40	0	48
Louisiana	57	74	26	53	0	21	7	0	19
Maine	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–
Massachusetts	358	56	44	42	13	2	12	21	10
Michigan	–	–	–	–	–	–	–	–	–
Minnesota	87	39	61	76	6	7	25	18	17
Mississippi	9	0	100	0	0	0	56	0	44
Missouri	148	42	58	34	0	7	33	0	25
Montana 495	36	64	14	21	1	13	46	5	
Nebraska	266	27	73	20	0	7	45	0	27
Nevada	88	63	38	15	40	8	2	27	8
New Hampshire	29	–	–	–	–	–	–	–	–
New Jersey	446	68	32	68	0	0	32	0	0
New Mexico	69	38	62	0	28	10	0	54	9
New York	2 905	60	40	54	0	7	25	0	14
North Carolina	427	20	80	5	15	0.5	16	51	13
North Dakota	7	0	100	0	0	0	29	71	0
Ohio	416	44	56	23	16	5	15	24	17
Oklahoma	59	29	71	22	0	7	63	0	8
Oregon	–	–	–	–	–	–	–	–	–
Pennsylvania	752 **	82	18	48	30	4	6	11	1
Puerto Rico	119	84	16	79	0	5	16	0	0
Rhode Island	18	89	11	6	83	0	0	11	0
South Carolina	–	–	–	–	–	–	–	–	–
South Dakota	32	75	25	63	9	3	22	3	0
Tennessee	103	36	64	23	0	7	11	0	38
Texas	425	30	70	22	0	8	42	0	28
Utah	338	52	48	37	0	15	31	0	17
Vermont	54	50	50	–	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–
West Virginia	46	17	83	–	–	–	–	–	–
Wisconsin	127	61	39	61	0	0	39	0	0
Wyoming	63	63	37	46	14	3	27	10	0
NATION	11 654	50	50	36	9	5	24	12	13

– Data not available; Main Assignment = Half time or more assigned to subject; 2nd or 3rd Assignment = Less than half time assigned to subject.

* = Main assignment only; ** = Grades 7–12; National totals include imputation for nonreporting states.

General secondary certification included in broad field category: California – 63 teachers; Connecticut – 9; Hawaii – 61; Illinois – 298; Massachusetts – 9; Ohio – 7.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.8: General, Physical, Integrated, Other Science, and Computer Science Teachers in Grades 9–12, by Time Assigned, 1994

	General Science		Physical Science		Integrated Science		Other Science		Computer Science	
STATE	Total	Main Assignmt. %	Total	Main Assignmt. %	Total	Main Assignmt. %	Total	Main Assignmt. %	Total	Main Assignmt. %
Alabama	57	0	684	2	2	0	2	0	100	1
Alaska	–	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–	–
Arkansas	170	25	486	49	–	–	133	14	127	24
California	612	34	1,869	39	–	–	1,252	36	373	13
Colorado	–	–	–	–	–	–	–	–	–	–
Connecticut	233	36	226	31	17	24	87	8	110	18
Delaware	82 *	100	–	–	–	–	0 *	–	5 *	–
Dist. of Columbia	64	100	–		–	–	12	100	32	100
Florida	–	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–	–
Hawaii	118	17	128	54	0	–	97	24	18	22
Idaho	20	10	115	30	–	–	0	–	148	21
Illinois	730	60	496	45	–	–	537	31	701	46
Indiana	260	30	364	45	84	25	4	0	212	18
Iowa	408	–	308		–	–	27	–	95	–
Kansas	–	–	–	–	–	–	–	–	–	–
Kentucky	–	–	358	42	356	37	35	6	103	19
Louisiana	84	70	345	70		–	11	27	58	57
Maine	–	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–	–
Massachusetts	253	58	318	53	35	54	158	22	425	50
Michigan	–	–	–	–	–	–	–	–	–	–
Minnesota	–	–	278	55	28	11	–	–	176	10
Mississippi	221	18	–	–	–	–	3	0	103	20
Missouri	306	27	708	42	–	–	94	22	206	33
Montana	22	18	31	19	19	37	4	0	69	9
Nebraska	253	32	335	4	–		187	14	513	25
Nevada	80	64	35	57	–		2	0	25	56
New Hampshire	108	–	31	–			–	–	–	–
New Jersey	463	56	591	70	–		133	79	555	52
New Mexico	103	32	179	44		–	45	80	61	28
New York	1,195	55	2,100	55	201	30	840	26	1,559	38
North Carolina	0	–	1,061	45	–	–	208	21	586	38
North Dakota	–	–	245	20	–	–	11	9	37	3
Ohio	1,157	34	576	46	–		13	31	745	32
Oklahoma	164	38	562	50	–	–	141	33	258	33
Oregon	351	80	299	73	156	69	–	–	173	49
Pennsylvania	2,458 **	77	275 **	55	53 **	51		–	83 **	43
Puerto Rico	358	58	40	45	–	–	–	–	–	–
Rhode Island	115	66	28	68	–	–	9	78	45	60
South Carolina	–	–	–	–	–	–	–	–	–	–
South Dakota	34	47	190	44	–	–	1	0	234	72
Tennessee	–	–	670	55	–	–	53	23	41	15
Texas	–	–	3,498	47	67	54	455	11	139	14
Utah	3	33	162	60	–	–	0	–	97	47
Vermont	22	32	27	44	7	0	29	24	43	33
Virginia	–	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–	–
West Virginia	54	48	221	57	187	61	190	33	123	42
Wisconsin	417	57	273	58	–	–	–	–	325	39
Wyoming	71	61	53	72	13	77	27	33	90	54
NATION	14,764	54 #	25,707	46 #	1,225 #	44 #	4800 #	29 #	8,793 #	36 #

– Data not available. * = Main assignment only. ** = Grades 7-12. # = Sum of reporting states.
National totals include imputation for nonreporting states.
Main Assignment = Half time or more assigned to subject.
2nd or 3rd Assignment = Less than half time assigned to subject.

State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.9: Grades 7–8 Mathematics Teachers by Time Assigned by Certification Status, 1994

		Mathematics Assignment		Certification					
				Main Assignment			2nd or 3rd Assignment		
STATE	Total Math Teachers (Grades 7–8)	Main %	2nd or 3rd %	% Certified Math	% Certified Elem./Middle	% Not Certified	% Certified Math	% Certified Elem./Middle	% Not Certified
Alabama	1,374	61	39	–	–	–	–	–	–
Alaska	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–
Arkansas	–	–	–	–	–	–	–	–	–
California	7,635	57	43	33	19	6	12	22	9
Colorado	1,071	78	22	43	20	15	3	6	13
Connecticut	928	74	26	42	31	0.1	6	19	1
Delaware	136 *	–	–	74	22	4	–	–	–
Dist. of Columbia	272	100	0	100	0	0	0	0	0
Florida	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–
Hawaii	297	61	39	37	14	10	1	24	15
Idaho	396	47	53	25	21	1	27	24	2
Illinois	2,748	81	19	0	80	2	0	18	1
Indiana	1,535	79	21	72	6	1	15	4	2
Iowa	–	–	–	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–	–	–
Kentucky	1,159	73	27	23	46	5	7	18	2
Louisiana	522	85	15	74	0	11	12	0	3
Maine	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–
Massachusetts	1,570	75	25	59	14	1	8	13	4
Michigan	–	–	–	–	–	–	–	–	–
Minnesota	796	61	39	60	0	1	36	0	3
Mississippi	951	71	29	26	44	0.2	11	19	0
Missouri	1,334	72	28	65	0	7	23	0	5
Montana	415	47	53	24	23	0	26	26	1
Nebraska	212	94	6	89	0	5	3	0	3
Nevada	310	90	10	52	38	0	4	6	0
New Hampshire	103	–	–	–	–	–	–	–	–
New Jersey	2,516	77	23	77	0	0	23	0	0
New Mexico	437	74	26	28	41	5	11	15	1
New York	6,964	69	31	65	0	3	27	0	4
North Carolina	2,779	42	58	37	2	3	31	3	23
North Dakota	470	28	72	20	8	0	38	34	0
Ohio	2,787	64	36	36	25	3	15	20	1
Oklahoma	1,185	59	41	31	27	1	23	15	2
Oregon	667	77	23	–	–	–	–	–	–
Pennsylvania	–	–	–	–	–	–	–	–	–
Puerto Rico	1,513	77	23	64	0	13	20	0	3
Rhode Island	244	98	2	98	0	0	2	0	0
South Carolina	–	–	–	–	–	–	–	–	–
South Dakota	338	67	33	66	0	1	31	0	1
Tennessee	–	–	–	–	–	–	–	–	–
Texas	8,826	55	45	20	0	35	3	0	42
Utah	293	80	20	69	0	11	14	0	6
Vermont	266	78	22	–	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–
West Virginia	801	76	24	–	–	–	–	–	–
Wisconsin	1,050	83	17	–	–	–	–	–	–
Wyoming	231	81	19	65	16	0	9	11	0
NATION	80,966	65	35	40	13	11	14	8	14

– Data not available; Main Assignment = Half time or more assigned to subject; 2nd or 3rd Assignment = Less than half time assigned to subject.
Certified Elem./Middle = Certified to teach General Elementary, Middle/Junior High, General Secondary, or Science.
* = Main assignment only. National totals include imputation for nonreporting states. Texas: % not certified includes elem./middle.

State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.10: **Grades 7–8 Science Teachers by Time Assigned by Certification Status, 1994**

		Science Assignment		Certification					
				Main Assignment			2nd or 3rd Assignment		
STATE	Total Science Teachers (Grades 7–8)	Main %	2nd or 3rd %	% Certified Science	% Certified Elem./Middle	% Not Certified	% Certified Science	% Certified Elem./Middle	% Not Certified
Alabama	1,243	61	39	–	–	–	–	–	–
Alaska	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–
Arkansas	–	–	–	–	–	–	–	–	–
California	5,558	65	35	47	11	6	14	14	7
Colorado	1,001	79	21	60	11	8	8	5	8
Connecticut	823	82	18	55	27	0.1	4	14	0.2
Delaware	125 *	–	–	79	13	8	–	–	–
Dist. of Columbia	130	100	0	100	0	0	0	0	0
Florida	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–
Hawaii	204	55	45	39	8	8	0.5	25	19
Idaho	346	58	42	47	10	0.3	27	13	2
Illinois	2,587	84	16	0	81	3	0	15	1
Indiana	1,430	83	17	79	3	1	13	2	2
Iowa	–	–	–	–	–	–	–	–	–
Kansas	–	–	–	–	–	–	–	–	–
Kentucky	1,007	78	22	21	47	10	5	15	2
Louisiana	493	83	17	70	0	13	9	0	8
Maine	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–
Massachusetts	1,478	78	22	63	13	2	7	11	4
Michigan	–	–	–	–	–	–	–	–	–
Minnesota	732	67	33	57	0	10	23	0	10
Mississippi	836	69	31	41	28	0	11	19	0.1
Missouri	1,288	73	27	60	0	13	21	0	6
Montana	367	54	46	23	29	0.3	20	26	2
Nebraska	194	89	11	71	0	19	5	0	6
Nevada	232	90	10	44	46	0	4	6	0
New Hampshire	–	–	–	–	–	–	–	–	–
New Jersey	1,508	87	13	87	0	0	13	0	0
New Mexico	423	76	24	53	20	3	9	15	0
New York	5,481	69	31	63	0	6	24	0	7
North Carolina	2,492	48	52	41	2	5	27	3	22
North Dakota	381	31	69	24	7	0	46	24	0
Ohio	2,375	70	30	30	35	4	8	21	1
Oklahoma	1,100	62	38	44	17	0.5	23	13	2
Oregon	497	89	11	–	–	–	–	–	–
Pennsylvania	–	–	–	–	–	–	–	–	–
Puerto Rico	796	86	14	86	0	0	13	0	0.4
Rhode Island	232	96	4	96	0	0	4	0	0
South Carolina	–	–	–	–	–	–	–	–	–
South Dakota	319	72	28	68	0	4	24	0	4
Tennessee	–	–	–	–	–	–	–	–	–
Texas	6,196	67	33	44	0	23	11	0	22
Utah	251	71	29	53	0	18	19	0	10
Vermont	235	85	15	–	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–
West Virginia	536	84	16	–	–	–	–	–	–
Wisconsin	999	81	19	–	–	–	–	–	–
Wyoming	199	81	19	64	17	0	11	8	0
NATION	65,023	70	30	49	13	9	14	7	9

– Data not available; Main Assignment = Half time or more assigned to subject; 2nd or 3rd Assignment = Less than half time assigned to subject.

Certified Elem./Middle = Certified to teach General Elementary, Middle/Junior High, General Secondary, or Math.

* = Main assignment only. National totals include imputation for nonreporting states. Texas: % not certified includes elem./middle.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.11: **Age of Science and Mathematics Teachers, Grades 9–12, 1994**

STATE	Math Total Teachers	% Under Age 30	% Age 30-49	% Over Age 50	Biology Total Teachers	% Under Age 30	% Age 30-49	% Over Age 50	Chemistry Total Teachers	% Under Age 30	% Age 30-49	% Over Age 50	Physics Total Teachers	% Under Age 30	% Age 30-49	% Over Age 50
Alabama	1,670	18	63	18	884	15	67	18	393	17	65	18	286	18	62	20
Alaska	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Arkansas	687 *	21	64	15	636	17	67	17	330	17	68	15	247	14	68	17
California	9,301	11	57	31	3,663	10	63	27	1,532	10	62	27	981	9	59	31
Colorado	1,319	10	64	26	1,157 ***	8	65	27	–	–	–	–	–	–	–	–
Connecticut	1,529	6	63	31	709	5	67	29	398	7	61	32	267	4	60	37
Delaware	200 *	17	60	23	64 *	16	66	19	22 *	9	59	32	29 *	34	28	38
Dist. of Columbia	306	–	–	–	92	–	–	–	45			–	21	–	–	–
Florida	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hawaii	560	20	57	23	187	13	66	21	65	6	69	25	49	20	53	27
Idaho	764	18	62	21	278	12	66	22	134	10	63	28	97	12	59	29
Illinois	4013	16	56	28	1,604	15	53 *	32	1,075	13	53	34	685	14	57	29
Indiana	2,335	16	62	22	1,061	12	62	26	558	16	56	28	384	15	54	31
Iowa	1,495	16	58	26	732	14	57	29	425	16	53	30	375	13	57	30
Kansas	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Kentucky	1,606	22	63	15	752	16	65	19	399	21	63	16	226	19	62	20
Louisiana	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Maine	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Massachusetts	2,495	7	63	29	1,014	8	64	28	627	6	56	36	415	6	56	36
Michigan	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Minnesota	1,810	13	51	35	795	11	51	38	511	12	49	39	70	11	51	38
Mississippi	1,133	17	64	19	813	16	62	23	332	11	64	25	08	11	64	25
Missouri	2,109	17	61	22	1,089	16	63	21	605	16	60	24	77	14	62	24
Montana	520	16	59	25	267	12	67	22	162	14	64	22	141	11	65	24
Nebraska	1,241	19	59	22	598	17	63	21	311	15	57	28	275	16	56	28
Nevada	576	14	66	19	249	16	61	23	89	8	67	25	53	13	68	19
New Hampshire	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New Jersey	4,180	10	62	29	1,261	10	61	30	745	8	55	37	340	10	55	35
New Mexico	755	13	65	22	363	13	67	19	146	12	68	21	92	5	74	21
New York	7,823	10	63	27	5,348	11	63	26	1,919	10	58	31	1,160	10	56	34
North Carolina	4,263	20	61	19	1,289	19	61	20	593	18	60	22	330	15	65	19
North Dakota	470	18	63	18	269	14	65	21	177	15	62	23	133	8	63	29
Ohio	4,756	17	65	18	1,932	12	66	22	1,063	13	65	23	769	13	66	21
Oklahoma	1,792	18	67	15	983	19	66	15	494	15	67	18	287	12	62	25
Oregon	1,167	13	64	23	382	10	66	24	–	–	–	–	–	–	–	–
Pennsylvania	6,431 **	11	61	28	1,976 **	10	57	33	1,098 **	12	51	37	702 **	15	51	34
Puerto Rico	1712	–	–	–	80	–	–	–	279	–	–	–	159	–	–	–
Rhode Island	416	7	70	22	173	6	72	22	93	6	61	32	63	5	65	30
South Carolina	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
South Dakota	484	22	56	22	255	15	63	22	159	21	54	25	131	15	60	25
Tennessee	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Texas	11,215	–	–	–	7,622	–	–	–	1,878	–	–	–	1,069	–	–	–
Utah	1,321	18	58	24	502	15	62	23	139	14	60	26	85	7	65	28
Vermont	275	9	66	25	110	6	82	12	76	7	68	25	49	0	71	29
Virginia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
West Virginia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wisconsin	2,010	13	57	30	914	10	55	35	559	11	56	33	399	12	52	36
Wyoming	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NATION	116,530	15	62	23	54,413	15	61	24	23,894	13	61	26	15,257	11	62	27

– Data not available. * = Main assignment only. ** = Grades 7-12. *** = Science, all fields. National totals include imputation for nonreporting states.

State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.12: **Gender of Science and Mathematics Teachers, Grades 9–12, 1994**

STATE	Math Total Teachers	% Male	% Female	Biology Total Teachers	% Male	% Female	Chemistry Total Teachers	% Male	% Female	Physics Total Teachers	% Male	% Female
Alabama	1,670	33	68	884	38	61	393	38	63	286	48	52
Alaska	–	–	–	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–	–	–	–
Arkansas	687 *	43	57	636	48	52	330	54	46	247	60	40
California	9,301	63	36	3,663	64	35	1,532	69	31	981	82	17
Colorado	1,319	58	42	1157 ***	67	33	–	–	–	–	–	–
Connecticut	1,529	52	48	709	57	43	398	62	38	267	84	16
Delaware	200 *	44	57	64 *	58	42	22 *	68	32	29 *	66	324
Dist. of Columbia	306	–	–	92	–	–	45	–	–	21	–	–
Florida	–	–	–	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–	–	–	–
Hawaii	560	43	57	187	48	52	65	51	49	49	61	39
Idaho	764	65	35	278	80	20	134	78	22	97	82	18
Illinois	4,013	54	46	1,604	60	40	1,075	64	36	685	80	20
Indiana	2,335	59	41	1,061	69	31	558	63	37	384	83	17
Iowa	1,495	69	31	732	77	23	425	76	24	375	78	22
Kansas	–	–	–	–	–	–	–	–	–	–	–	–
Kentucky	1,606	39	61	752	45	55	399	48	52	226	68	32
Louisiana	–	–	–	–	–	–	–	–	–	–	–	–
Maine	–	–	–	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–	–	–	–
Massachusetts	2,495	55	45	1,014	59	41	627	65	35	415	85	15
Michigan	–	–	–	–	–	–	–	–	–	–	–	–
Minnesota	1,810	71	29	795	75	25	511	78	22	370	86	14
Mississippi	1,133	36	64	813	44	56	332	45	55	208	50	50
Missouri	2,109	47	53	1,089	55	45	605	55	45	377	70	30
Montana	520	71	29	267	82	18	162	80	20	141	86	14
Nebraska	1,241	60	40	598	71	29	311	73	27	275	79	21
Nevada	576	61	39	249	58	42	89	70	30	53	75	25
New Hampshire	–	–	–	–	–	–	–	–	–	–	–	–
New Jersey	4,180	41	59	1,261	53	47	745	62	38	340	81	19
New Mexico	755	54	46	363	64	36	146	62	38	92	73	27
New York	7,823	54	46	5,348	59	41	1,919	67	33	1,160	82	18
North Carolina	4,263	31	69	1,289	40	60	593	45	55	330	65	35
North Dakota	470	66	34	269	70	30	177	74	26	133	73	27
Ohio	4756	57	43	1,932	65	35	1,063	64	36	769	74	26
Oklahoma	1,792	48	52	983	59	41	494	59	41	287	71	29
Oregon	1,167	71	29	382	73	27	–	–	–	–	–	–
Pennsylvania	6,431 **	57	43	1976 **	65	35	1,098 **	68	32	702 **	82	18
Puerto Rico	1,712	–	–	80			279	–	–	159	–	–
Rhode Island	416	52	48	173	59	41	93	61	39	63	86	14
South Carolina	–	–	–	–	–	–	–	–	–	–	–	–
South Dakota	484	62	38	255	72	28	159	66	34	131	69	31
Tennessee	–	–	–	–	–	–	–	–	–	–	–	–
Texas	11,215	40	60	7,622	45	55	1,878	50	50	1,069	67	33
Utah	1,321	60	40	502	72	28	139	77	23	85	82	18
Vermont	275	56	44	110	74	26	76	71	29	49	100	0
Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–	–	–	–
West Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Wisconsin	2,010	66	34	914	78	22	559	78	22	399	86	14
Wyoming	–	–	–	–	–	–	–	–	–	–	–	–
NATION	116,530	50	50	54,413	55	45	23,894	60	40	15,257	75	25

– Data not available; * = Main assignment only; ** = Grades 7–12; *** = Science, all fields. National totals include imputation for nonreporting states.

State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Appendix D.13: **Race/Ethnicity of Teachers Assigned in Mathematics and Biology, Grades 9–12, 1994**

STATE	Math Total Teachers	% Hispanic	% White	% Black	% Asian	% Am. Ind.	Biology Total Teachers	% Hispanic	% White	% Black	% Asian	% Am. Ind.
Alabama	1,670	0.1	86	15	0.2	0.1	884	0.1	82	17	1	0.20
Alaska	–	–	–	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–		–	–	–	–	–
Arkansas	687 *	0	92	7	0.3	0.1	636	0.2	91	8	0.3	0.2
California	9,301	7	82	4	6	1	3,663	7	82	5	5	1
Colorado	1,319	3	95	1	1	0.3	1,157 ***	3	94	1	1	1
Connecticut	1,529	1	96	2	1	0.1	709	2	94	3	1	0
Delaware	200 *	1	94	6	1	0	64 *	0	97	3	0	0
Dist. of Columbia	306	–	–	–	–	–	92	–	–	–	–	–
Florida	–	–	–	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–	–	–	–
Hawaii	560	0.4	34	1	60	5	187	1	36	1	58	4
Idaho	764	0.3	99	0	1	0.3	278	0.4	99	0	0	1
Illinois	4,013	1	90	7	1	0.1	1,604	1	89	9	1	0.1
Indiana	2,335	0.1	97	2	0.3	0.2	1,061	0.4	96	3	0	0.2
Iowa	1,495	0.1	99	0.2	0.2	0.2	732	0.1	99	0.1	0.1	0.4
Kansas	–	–	–	–	–	–	–	–	–	–	–	–
Kentucky	1,606	0	98	2	0.1	0	752	0.1	97	3	0.3	0
Louisiana	–	–	–	–	–	–	–	–	–	–	–	–
Maine	–	–	–	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–	–	–	–
Massachusetts	2,495	2	94	3	1	0	1,014	3	93	4	1	0.1
Michigan	–	–	–	–	–	–	–	–	–	–	–	–
Minnesota	1,810	0	99	0.1	1	0.2	795	0	100	0.4	0	0
Mississippi	1,133	0.1	77	23	0.2	0.1	813	0.2	73	26	0.2	0.1
Missouri	2,109	0.1	95	4	1	0	1,089	0.1	95	4	0.1	0
Montana	520	0	99	0.2	0	1	267	0	100	0	0	0
Nebraska	1,241	0.4	99	1	0	0	598	1	99	0.3	0	0
Nevada	576	1	91	2	3	1	249	4	90	3	1	1
New Hampshire	–	–	–	–	–	–	–	–	–	–	–	–
New Jersey	4,180	2	91	5	1	0	1,261	2	91	5	2	0.1
New Mexico	755	18	79	1	1	1	363	19	80	0.3	1	0
New York	7,823	–	–	–	–	–	5,348	–	–	–	–	–
North Carolina	4,263	0.2	87	12	0.2	1	1,289	0.2	85	14	0.1	1
North Dakota	470	0	100	0	0	0.2	269	0	100	0	0.4	0
Ohio	4,756	0.2	96	3	0.3	0.1	1,932	0.2	95	4	0.3	0
Oklahoma	1,792	0.1	96	2	0.1	2	983	0.4	95	3	0.1	2
Oregon	1,167	1	96	0.3	2	0.30	382	1	96	1	2	0.3
Pennsylvania	6,431 **	0.2	95	4	0.50	0	1,976 **	0.3	97	3	0.4	0
Puerto Rico	1,712	100	0	0	0	0	80	100	0	0	0	0
Rhode Island	416	1	97	1	0.2	0.5	173	2	95	2	1	0
South Carolina	–	–	–	–	–	–	–	–	–	–	–	–
South Dakota	484	0	100	0	0	0	255	0	100	0.4	0	0
Tennessee	–	–	–	–	–	–	–	–	–	–	–	–
Texas	11,215	11	81	7	1	0.1	7,622	11	79	9	0.5	0.2
Utah	1,321	0.4	98	0.1	1	0.2	502	0	99	0.2	1	0
Vermont	275	–	–	–	–	–	110	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–	–	–	–
West Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Wisconsin	2,010	0.1	99	1	0.2	0.2	914	0.2	98	1	0.3	0
Wyoming	–	–	–	–	–	–	–	–	–	–	–	–
NATION	116,530	5	89	5	1	0.3	54,413	5	87	7	1	0.3

– Data not available; * = Main assignment only; ** = Grades 7–12; *** = Science, all fields.
National totals include imputation for nonreporting states.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.14: Race/Ethnicity of Teachers Assigned in Chemistry and Physics, Grades 9–12, 1994

STATE	Chemistry Total Teachers	% Hispanic	% White	% Black	% Asian	% Am. Ind.	Physics Total Teachers	% Hispanic	% White	% Black	% Asian	% Am. Ind
Alabama	393	0	86	14	0.3	1	286	0	90	10	0	0.3
Alaska	–	–	–	–	–	–	–	–	–	–	–	–
Arizona	–	–	–	–	–	–	–	–	–	–	–	–
Arkansas	330	0.3	94	5	0	0	247	0	96	4	0	0
California	1,532	4	86	3	6	1	981	3	88	2	5	1
Colorado	–	–	–	–	–	–	–	–	–	–	–	–
Connecticut	398	2	96	2	1	0	267	1	98	0	1	0.4
Delaware	22 *	0	100	0	0	0	29 *	0	93	3	3	0
Dist. of Columbia	45	–	–	–	–	–	21	–	–	–	–	–
Florida	–	–	–	–	–	–	–	–	–	–	–	–
Georgia	–	–	–	–	–	–	–	–	–	–	–	–
Hawaii	65	0	40	2	54	5	49	0	39	0	55	6
Idaho	134	0	100	0	0	0	97	0	100	0	0	0
Illinois	1,075	1	92	5	1	0	685	0.3	96	2	1	0
Indiana	558	1	97	2	1	0.2	384	0	99	0.3	1	0.3
Iowa	425	0.2	99	0.2	0.0	0.2	375	0	100	0	0	0.3
Kansas	–	–	–	–	–	–	–	–	–	–	–	–
Kentucky	399	0.3	99	1	0.3	0	226	0.4	99	0.4	0	0
Louisiana	–	–	–	–	–	–	–	–	–	–	–	–
Maine	–	–	–	–	–	–	–	–	–	–	–	–
Maryland	–	–	–	–	–	–	–	–	–	–	–	–
Massachusetts	627	2	96	1	1	0	415	2	97	0.2	1	0
Michigan	–	–	–	–	–	–	–	–	–	–	–	–
Minnesota	511	0	99	0.4	0.2	0	370	0.0	99	1	0.3	0
Mississippi	332	0	75	24	0	1	208	0	77	22	0.5	0.5
Missouri	605	0	97	2	0.3	0	377	0	99	1	0.3	0
Montana	162	0	100	0	0	0	141	0	99	1	0	0
Nebraska	311	1	99	0	0	0	275	0.4	100	0	0	0
Nevada	89	0	97	1	1	0	53	0	96	0	2	2
New Hampshire	–	–	–	–	–	–	–	–	–	–	–	–
New Jersey	745	1	94	4	1	0.1	340	0.3	96	2	2	0
New Mexico	146	13	85	0	1	1	92	20	80	0	0	0
New York	1,919	–	–	–	–	–	1,160	–	–	–	–	–
North Carolina	593	0	89	10	0.3	1	330	0	93	6	0	1
North Dakota	177	0	99	0	1	0	133	0	100	0	0	0
Ohio	1,063	0	97	2	0.5	0	769	0	99	1	0.3	0
Oklahoma	494	0.4	96	1	0	2	287	1	97	1	0	1
Oregon	–	–	–	–	–	–	–	–	–	–	–	–
Pennsylvania	1,098 **	0	99	1	0.1	0	702 **	0	98	1	1	0.1
Puerto Rico	279	100	0	0	0	0	159	100	0	0	0	0
Rhode Island	93	0	94	0	1	0	63	0	95	2	0	0
South Carolina	–	–	–	–	–	–	–	–	–	–	–	–
South Dakota	159	0	99	0	1	0	131	0	99	0	1	0
Tennessee	–	–	–	–	–	–	–	–	–	–	–	–
Texas	1,878	8	87	4	1	0.5	1,069	6	91	2	1	1
Utah	139	0	99	0	1	0	85	1	98	0	0	1
Vermont	76	–	–	–	–	–	49	–	–	–	–	–
Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Washington	–	–	–	–	–	–	–	–	–	–	–	–
West Virginia	–	–	–	–	–	–	–	–	–	–	–	–
Wisconsin	559	0	99	1	0.2	0.4	399	0	100	0	0.3	0
Wyoming	–	–	–	–	–	–	–	–	–	–	–	–
NATION	23,894	4	92	4	1	0.4	15,257	3	94	2	1	0.4

– Data not available; * = Main assignment only; ** = Grades 7–12; *** = Science, all fields.
National totals include imputation for nonreporting states.

State Departments of Education, Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix D.15: Average Class Size in Mathematics and Science and Percent Classes Over 30 Students, Grades 9–12, 1990–91

STATE	All Math Average Class	% All Classes Over 30	Adv. Math Average Class	% Advanced Over 30	All Science Average Class	% All Classes Over 30	Biology Average Class	% Biology Over 30
Alabama	21	8	19	3	24	17	23	8
Alaska	19	10	–	–	20	13	18	16
Arizona	22	12	25	23	24	13	25	18
Arkansas	20	<1	–	–	21	2	20	<1
California	26	29	29	37	27	27	26	22
Colorado	21	5	21	8	24	8	23	7
Connecticut	19	<1	19	0	20	3	–	–
Delaware	–	–	–	–	–	–	–	–
Dist. of Columbia	–	–	–	–	–	–	–	–
Florida	26	30	30	50	24	22	25	22
Georgia	21	10	24	15	24	12	22	<1
Hawaii	19	8	–	–	–	–	–	–
Idaho	20	8	20	12	23	5	24	3
Illinois	22	8	21	7	22	11	21	<1
Indiana	18	3	20	4	23	4	21	<1
Iowa	20	1	18	<1	21	1	21	<1
Kansas	19	9	14	<1	20	5	22	<1
Kentucky	22	12	23	12	24	11	23	9
Louisiana	21	7	21	7	26	18	25	16
Maine	17	<1	16	0	19	<1	–	–
Maryland	22	13	23	10	24	22	23	17
Massachusetts	19	2	21	<1	21	3	22	<1
Michigan	22	12	24	8	23	11	23	11
Minnesota	23	13	25	22	25	8	25	8
Mississippi	21	6	20	<1	24	14	24	13
Missouri	20	2	19	3	21	3	20	<1
Montana	18	1	19	<1	16	<1	17	<1
Nebraska	18	1	18	<1	19	4	19	<1
Nevada	23	16	–	–	24	16	–	–
New Hampshire	19	<1	–	–	19	0	–	–
New Jersey	17	<1	20	0	20	1	19	<1
New Mexico	23	12	27	24	22	8	22	7
New York	19	8	21	15	24	21	28	0
North Carolina	22	4	23	6	22	3	–	–
North Dakota	17	1	15	<1	19	5	18	<1
Ohio	20	2	21	<1	22	5	22	6
Oklahoma	17	2	16	<1	20	6	19	3
Oregon	21	6	22	6	22	6	22	6
Pennsylvania	21	3	21	<1	22	9	–	–
Rhode Island	–	–	–	–	–	–	–	–
South Carolina	20	2	19	<1	23	8	23	4
South Dakota	19	4	16	4	20	4	19	3
Tennessee	22	14	23	15	26	19	27	28
Texas	20	3	18	2	23	5	23	6
Utah	25	29	27	35	28	42	26	23
Vermont	18	3	–	–	18	<1	–	–
Virginia	21	4	22	6	22	1	–	–
Washington	23	8	23	17	26	17	27	19
West Virginia	20	2	20	2	21	3	20	1
Wisconsin	21	5	19	6	22	5	23	<1
Wyoming	17	<1	–	–	17	<1	17	<1
NATION	21	9	22	11	23	11	23	10

Data not available. <1 = Less than 1% of classes. — = Respondents too few for a reliable state estimate; see standard errors in Appendix F.

NCES, Schools and Staffing Survey, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix E
Indicators for Cities in Urban Systemic Initiatives

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Appendix E.1: High School Math and Science in Cities in Urban Systemic Intiative (USI), Percentage of High School Students Taking Selected Mathematics and Science Courses by Graduation, 1994

STATE/DISTRICT	Algebra 1/ Integrated Math 1	Geometry/ Integrated Math 2	Algebra 2/ Integrated Math 3	Trigonometry/ Pre-Calculus	Calculus	Biology 1st Year	Chemistry 1st Year	Physics 1st Year
California	95+	53	48	24	9	84	38	18
Fresno	95+	35	55	22	8	82	40	23
Los Angeles	79	45	46	21	9	88	36	12
San Diego	90	38	40	42	7	34	35	32
Illinois	–	–	–	–	–	–	–	–
Chicago	–	–	–	–	–	–	–	–
Indiana	88	63	54	33	14	95+	53	22
Indianapolis	87	40	30	9	9	87	36	12
Louisiana	95+	90	67	30	6	95+	58	23
New Orleans	–	–	–	–	–	–	–	–
Massachusetts	94	65	65	42	13	92	63	34
Boston	88	63	47	34	7	95+	42	20
Missouri	95+	71	70	33	13	95+	52	19
St. Louis City	95+	66	–	23	5	91	86	35
New York	82	60	50	29	13	95+	61	31
New York City	78	41	33	17	13	95+	49	29
Ohio	95+	68	58	36	10	95+	57	22
Cincinnati	82	64	51	30	13	95+	88	28
Cleveland	67	52	53	84	4	95+	37	16
Columbus	83	57	55	18	5	69	49	26
Pennsylvania	95+	65	66	58	17	95+	62	31
Philadelphia	92	53	52	37	8	95+	65	33
Texas	95+	69	68	37	8	95+	49	16
Dallas	95+	84	80	23	8	95+	51	13
El Paso	75	67	76	30	8	86	46	12
Houston	92	80	76	33	8	95+	49	16
San Antonio	95+	55	61	27	4	95+	48	14
Wisconsin	95+	86	65	45	13	95+	71	31
Milwaukee	95+	61	37	6	33	95+	49	22

– Data not available

State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995

Appendix E.2: Cities in Urban Sytemic Initiative (USI), Certification of Mathematics and Science Teachers, Grades 9–12, 1994

STATE/DISTRICT	% Certified Math	% Certified Biology	% Certified Chemistry	% Certified Physics	% Certified Earth Science
California	82	86	84	86	85
Fresno	57	69	71	88	–
Los Angeles	81	86	93	91	100
San Diego	–	–	–	–	–
Illinois	96	95	94	96	94
Chicago	94	90	91	90	100
Indiana	97	96	96	85	74
Indianapolis	87	96	100	67	80
Louisiana	92	86	85	70	60
New Orleans	91	79	81	55	100
Massachusetts	91	93	97	97	88
Boston	54	59	89	100	62
Missouri	98	96	95	81	67
St. Louis City	96	88	100	100	100
New York	92	92	92	87	79
New York City	90	84	88	91	81
Ohio	95	89	94	93	78
Cincinnati	97	71	85	91	14
Cleveland	94	61	91	100	0
Columbus	98	93	100	86	80
Pennsylvania	90	94	94	93	95
Philadelphia	96	99	100	100	100
Texas	74	75	86	80	64
Dallas	66	74	80	85	100
El Paso	61	53	100	100	78
Houston	70	53	78	77	40
San Antonio	70	80	95	100	88
Wisconsin	100	100	100	100	100
Milwaukee	–	–	–	–	–

Note: – Data not available.

% Certified = Teachers assigned 1 or more period to subject who have state certification in subject.

Science % Certified = Specific field or broad-field certification.

Pennsylvania and Philadelphia = Grades 7–12.

Source: State Departments of Education, Data on Public Schools, 1993–94

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix E.3: **Cities in Urban Systemic Intiative (USI), Certification of Grades 7–8 Mathematics and Science Teachers, 1994**

	Mathematics Grades 7–8			Science Grades 7–8		
STATE DISTRICT	% Certified Math	% Certified Elementary	% Not Certified	% Certified Science	% Certified Elementary	% Not Certified
California	45	41	14	61	25	14
Fresno	42	13	45	73	4	24
Los Angeles	62	28	11	73	16	12
San Diego	–	–	–	–	–	–
Illinois	0	98	3	0	96	5
Chicago	0	87	13	0	89	11
Indiana	87	10	3	92	5	3
Indianapolis	80	10	10	83	11	6
Louisiana	86	0	14	79	0	21
New Orleans	68	0	32	69	0	31
Massachusetts	67	27	5	70	24	6
Boston	49	23	28	47	19	35
Missouri	88	0	12	81	0	19
St. Louis City	45	0	55	56	0	44
New York	92	0	8	87	0	13
New York City	86	0	14	80	0	20
Ohio	51	45	5	38	56	5
Cincinnati	50	46	1	27	67	3
Cleveland	73	24	3	51	41	8
Columbus	68	28	4	41	54	4
Pennsylvania	–	–	–	–	–	–
Philadelphia	–	–	–	–	–	–
Texas	23	0	77	55	0	45
Dallas	9	0	91	60	0	40
El Paso	12	0	88	30	0	70
Houston	3	0	97	37	0	63
San Antonio	8	0	92	59	0	41
Wisconsin	–	–	–	–	–	–
Milwaukee	–	–	–	–	–	–

– Data not available.

Certified math (science) = Teachers assigned one or more period to subject who have state certification in secondary math (science) or middle level math (science).

Certified Elementary = Certification in Elementary Education, General Secondary/Middle, or science (math).

Texas: % not certified includes % certified elementary.

State Departments of Education: Data on Public Schools, 1993–94.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

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Appendix F
Data Sources and Computations

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Data Sources

National Assessment of Educational Progress (NAEP)

The National Assessment of Educational Progress (NAEP) is a congressionally mandated project of the National Center for Education Statistics (NCES) that has collected and reported information for nearly 25 years on what U.S. students know and what they can do. It is the nation's only ongoing, comparable, and representative assessment of student achievement. Its assessments are given to scientific samples of youths attending both public and private schools and enrolled in grades 4, 8, or 12. The assessment questions are written around a framework prepared for each content area—reading, writing, math, science, and others—that represents the consensus of groups of curriculum experts, educators, members of the general public, and user groups on what should be covered on such a test. Reporting includes means and distributions of scores, as well as more descriptive information about the meaning of different points on the NAEP scale.

NAEP's 1992 mathematics assessment included nearly 250,000 4th, 8th, and 12th grade students attending approximately 10,000 schools across the nation and the states. The assessment itself was forward looking, comprising several hundred questions at each of the grades assessed. Consistent with the standards of the National Council of Teachers of Mathematics (NCTM), many of the questions required students to construct their responses, and some questions asked for explanations of their reasoning. For various portions of the assessment, mathematical tools and aids were supplied, including scientific calculators, protractor/rulers, and geometric shapes. One portion was administered using a special audiotape to pace students through estimation questions.

Nationally representative samples of students attending both public and private schools were assessed at grades 4, 8, and 12. In addition, samples of 4th and 8th graders attending public schools were assessed in 41 states and three jurisdictions.

Schools and Staffing Survey (SASS)

In the 1987–88 school year, NCES launched a new survey with the goal of obtaining comprehensive, reliable data on the characteristics and condition of the nation's elementary and secondary schools and the teachers and administrators in the schools. The Schools and Staffing Survey (SASS) is conducted through questionnaires mailed to teachers, principals, and district administrators in a sample of the nation's public and private schools. It was conducted again in 1990–91 and 1993–94, and will be conducted again in 1997–98.

The SASS is designed to provide data on the nation's elementary and secondary teaching force, aspects of teacher supply and demand, teacher workplace conditions, characteristics of school administrators, and school policies and practices. A major purpose of SASS is to provide comparable, reliable, state-level statistics on the characteristics of schools and educators. The sample is designed to provide national estimates of schools, districts, teachers, and principals, and state-level estimates for public schools, districts, teachers, and principals. In the 1990–91 school year, SASS was administered for the second time. The sample for the 1990–91 survey comprised 9,500 public schools and principals, 5,400 school districts, and 56,000 public school teachers. The sample also included 3,000 private schools and 9,000 private school teachers. The survey sample was representative of public schools and teachers in each state. The average state sample was 183 schools and 939 teachers.

Advanced Placement Examination (AP)

The Advanced Placement (AP) Program, a cooperative educational endeavor, is based on the premise that college-level material can be taught successfully to able and well-prepared secondary school students. Participating colleges, in turn, grant credit or appropriate placement to students who have done well on the AP Examinations. Almost 50 percent of the nation's 21,000 high schools offer some college-level AP coursework, and more than 400,000 students participate in the AP Program each year. Use by both schools and students has grown steadily in recent years.

In response to increased interest in the AP Program, the College Board produces, as part of its reporting process, a series of tables reflecting student participation in the 1994 AP Examinations. A more detailed understanding of AP trends and related information can be found in the companion publication, the *1994 AP Yearbook*.

The College Board annually publishes summary reports for the nation and for each of the 50 states. The reports give tables with the number of students taking examinations and the number receiving each grade: 1 = no recommendation, 2 = possibly qualified, 3 = qualified, 4 = well qualified, 5 = extremely well qualified.

State Data

State departments of education report aggregated totals on course enrollments and teacher characteristics in science and mathematics to CCSSO. Data are collected by states through state management information systems. Nine states report their data from student unit-record systems and teacher files, and the remaining states report data from school records and teacher files. The state totals for public schools are aggregated and reported to the Council using common data definitions and reporting forms (CCSSO, 1993b). The data refer to the status of students and teachers on or about October 1. Each state's data codes for course enrollments and teacher assignments are cross-walked by CCSSO staff using the course taxonomy and common data category definitions developed by CCSSO with the states (see Appendix G).

For the science and mathematics indicators from the 1993-94 school year, 43 states, District of Columbia, and Puerto Rico reported some state-collected data. Data on science and mathematics teachers were reported by 41 states, and course enrollments were reported by 39 states.

Computation of Estimated Proportion of High School Students Taking Selected Mathematics and Science Courses by Graduation

The percentages shown in Tables 6 and 7 for each course are statistical estimates of course taking of high school students by the time they graduate, based on the total course enrollment in grades 9–12 as of fall 1993 divided by the estimated number of students in a grade cohort during four years of high school.

Synthetic cohort statistics have been used previously in education. For example, a synthetic high school dropout statistic has been estimated, based on the sum of the percentages of students who drop out at each grade, for grades 9–12 (Kominski, 1993). Cross-sectional data on dropouts by grade are used to estimate a true dropout rate over a 4-year period of high school. A true dropout rate requires tracking the status of the same group of students (cohort) through four years of high school. If only cross-sectional data are available, the synthetic cohort statistic provides an estimate of the high school dropout rate.

The Science and Mathematics Indicators Project desired a synthetic cohort statistic of the proportion of graduates in a state that take a given course, e.g., Biology 1. Since most states do not collect data by grade, the approach used in computing a synthetic dropout statistic had to be revised. First, the numerator is the total number of students in grades 9–12 that took a given course, e.g., Biology, first year, in Fall 1993. The denominator is an estimate of the number of students in a cohort of students summed over a 4-year period of high school. For each state, the size of the cohort of students that have some probability of taking a given course, e.g., Biology 1, during four years of high school is estimated by: the state student membership in each grade (for grades 9–12) weighted by the regional percentage of students that took the course at each grade level, and summing the weighted memberships for each grade for grades 9–12. The state student memberships by grade are from the 1993–94 Common Core of Data (NCES) and the regional percentages were obtained from the 1990 National Transcript Study (Westat, 1993).

The computation of the science/mathematics course taking synthetic cohort statistic can be summarized as follows, using the example of Biology 1:

$$\text{Estimated proportion of students taking Biology 1 in state A} = \frac{\text{Biology 1 enrollment (9-12) (Reported by State A)}}{\text{Estimated number of students in cohort in grades 9-12 (from CCD and regional weights based on NAEP transcript study)}}$$

$$\text{Estimated students in cohort} = (M9 \times \text{Bio } 1/9) + (M10 \times \text{Bio } 1/10) + (M11 \times \text{Bio } 1/11) + (M12 \times \text{Bio } 1/12)$$

Where M9 is the student membership for grade 9 (from NCES Common Core of Data) Bio 1/9 is the percentage of 1990 graduates in state A's region that took Biology 1 in grade 9 (from Westat, Inc. transcript data files).

(Four regions designated by Westat—Northeast, North Central, South Central, and West.)

The estimated percentages of students taking a course by graduation, based on state data, can be compared with rates based on student transcripts from studies conducted by the National Center for Education Statistics. For example, national estimates of course-taking from 1991–92 aggregated state data (Blank & Gruebel, 1993) were: biology—95%, chemistry—49%, physics—21%; while figures from the national transcript study conducted under NELS Second-Follow-up (1992) were: biology—93%, chemistry—56%, physics—25%. In mathematics, state aggregate data reported: geometry—61%, algebra 2—55%, trigonometry/precalculus—29%, calculus—11%; while the NELS transcript study reported: geometry—70%, algebra 2—56%, trigonometry/pre-calculus—38%, calculus—16%. (We do not compare algebra 1 because transcript studies generally do not include 8th grade enrollments. State data showed 91 percent of students taking algebra 1 by graduation; while the transcript study reported 79 percent.)

Thus, the comparison of rates by the two data collection methods show that transcript data produce slightly higher rates of course-taking. One reason for the difference is that CCSSO state data were reported only during first semester (1993–94), while the transcript data count all courses taken whether they are year long, first semester, or second semester courses. The transcript study rates have a small standard error (1% to 2%), while CCSSO estimates from state data include some error introduced by imputation for missing states. The CCSSO data from states could also be compared to student self-report data from NAEP assessments in mathematics and science. However, comparisons of self-reported vs. transcript data show that self-report data often have slightly inflated rates of course-taking.

Variability is added to the state estimates through the weighted student membership based on regional weights. Since the weights are not state specific, each estimate has variability. For this reason, estimates over 95 percent of students cannot be made with precision; and enrollments at this level are shown in Tables 6 and 7 as 95+ percent.

Course enrollment rates are based on enrollment as of fall 1993. Some states collect data on student course taking for fall and spring semesters. The state comparisons are based on cross-sectional data collected as of October 1. The indicator does not account for course taking in spring semester courses.

Imputation of estimated proportion of high school graduates taking selected mathematics and science courses for nonreporting states. In 1993–94, 39 states were able to report course enrollment data to CCSSO. To obtain a national total for the estimated proportion of graduates taking selected mathematics and science courses, the state proportions were imputed. The following formula was used for imputation:

$$\text{Estimated proportion of students taking Biology 1 in nonreporting state B} = \frac{(\text{Reg. avg. \% taking Biology 1 (9–12)} \times \text{state B student membership (9–12)})}{\text{Sum of estimated numbers of students in cohort in grades 9–12}}$$

(from CCD and regional weights based on NAEP transcript study) (as above)

Where Reg. avg. % taking Biology 1 is the average (mean) percent of students taking Biology 1 among the reporting states in state B's region.

Imputation of number of teachers per field (in mathematics, biology, chemistry, etc.) for nonreporting states.

$$\text{Imputed number of teacher of mathematics in state C} = \frac{\text{State student membership (9–12)}}{\text{Regional ratio students/teacher}} \times \text{Regional ratio of mathematics teachers to total teachers (9–12)}$$

$$\text{Regional ratio students/teacher} = \frac{\text{State student membership (9–12)}}{\text{State total teachers (9–12)}} \times \text{Average for states in region}$$

$$\text{Regional ratio mathematics teachers to total teachers} = \frac{\text{State mathematics teachers (9–12)}}{\text{State total teachers (9–12)}} \times \text{Average for states in region}$$

Appendix F.3 Standard Errors for Table 14, Mathematics and Science Teachers with Major in Assigned Field, Grades 7–12, 1991

	Main Assignment		All Teachers	
STATE	Math % with Major in Math	Science % with Major in Science	Math % with Major or Minor	Science % with Major or Minor
Alabama	5.1	6.8	5.7	5.5
Alaska	10.1	4.8	6.8	7.5
Arizona	6.5	5.0	5.9	4.3
Arkansas	5.6	5.9	4.4	3.8
California	5.6	9.0	4.2	6.7
Colorado	7.2	5.0	5.5	4.2
Connecticut	8.1	7.7	5.9	5.4
Delaware	21.5	11.3	20.0	12.2
Dist. of Columbia	15.4	0.0	0.0	0.0
Florida	7.2	8.3	7.9	7.7
Georgia	8.1	7.8	6.1	8.7
Hawaii	15.9	8.4	7.4	12.3
Idaho	6.7	7.1	6.2	4.0
Illinois	7.6	4.4	5.9	4.7
Indiana	6.2	6.7	5.5	5.3
Iowa	6.2	12.4	7.2	11.3
Kansas	8.9	8.9	8.0	6.4
Kentucky	8.0	9.0	8.3	8.9
Louisiana	6.8	7.8	4.8	9.1
Maine	7.9	6.1	4.8	6.0
Maryland	7.5	8.4	6.9	9.2
Massachusetts	7.4	7.1	5.3	4.2
Michigan	7.8	6.2	5.6	6.7
Minnesota	5.5	4.1	5.2	4.6
Mississippi	6.2	6.2	5.0	5.8
Missouri	5.9	5.5	5.0	7.2
Montana	5.8	7.0	5.0	5.9
Nebraska	4.4	6.0	4.7	3.6
Nevada	12.8	9.4	7.5	9.2
New Hampshire	9.5	7.5	5.6	6.2
New Jersey	7.1	7.2	6.6	8.2
New Mexico	7.5	7.0	7.6	7.1
New York	6.3	7.5	5.0	4.3
North Carolina	7.3	5.2	6.5	5.2
North Dakota	5.0	5.2	4.1	3.9
Ohio	7.3	7.7	7.2	7.7
Oklahoma	6.2	6.5	4.2	4.5
Oregon	6.3	6.0	5.3	5.4
Pennsylvania	7.7	5.0	5.7	5.0
Rhode Island	10.4	13.5	9.1	12.6
South Carolina	8.7	7.5	6.2	6.0
South Dakota	5.2	6.6	3.9	5.0
Tennessee	7.2	6.0	8.5	5.9
Texas	4.7	7.3	4.9	4.8
Utah	6.3	6.6	5.4	5.3
Vermont	9.5	7.4	7.0	6.7
Virginia	6.4	7.4	5.5	6.8
Washington	8.2	5.4	6.4	5.4
West Virginia	6.5	7.1	5.8	4.8
Wisconsin	7.1	8.5	5.6	7.0
Wyoming	7.5	6.1	6.4	5.4
NATION	1.3	1.7	1.0	1.4

Source: U.S. Department of Education, National Center for Education Statistics, Schools and Staffing Survey, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix F.4 Standard Errors for Figures 20 and 21, Average Class Size in Mathematics and Science and Percent Classes Over 30 Students, Grades 9–12, 1991

STATE	All Math Average Class	Advanced Math Average Class	% Advanced Over 30	All Science Average Class	Biology Average Class	% Biology Over 30
Alabama	0.8	1.3	1.3	0.8	1.0	2.7
Alaska	1.2	–	–	1.5	2.3	7.9
Arizona	1.0	1.1	5.6	1.1	1.0	4.9
Arkansas	0.8	–	–	0.7	0.9	<1
California	0.8	0.7	7.7	0.8	0.9	3.9
Colorado	0.9	1.1	6.4	0.6	0.6	1.9
Connecticut	0.9	0.9	0.0	2.0	–	–
Delaware	–	–	–	–	–	–
Dist. of Columbia	–	–	–	–	–	–
Florida	1.2	1.9	9.9	1.4	1.3	5.3
Georgia	1.2	1.5	4.7	0.9	1.3	<1
Hawaii	1.2	–	–	–	–	–
Idaho	0.8	1.4	5.4	0.7	0.8	1.2
Illinois	0.7	1.2	3.2	0.8	1.1	<1
Indiana	0.9	0.9	2.1	1.5	1.8	<1
Iowa	1.2	1.2	<1	1.0	0.9	<1
Kansas	1.2	1.1	<1	0.7	1.3	<1
Kentucky	1.3	1.2	7.6	0.9	2.0	3.7
Louisiana	1.1	1.3	2.6	1.2	1.5	5.8
Maine	0.7	0.8	0.0	1.6	–	–
Maryland	1.1	1.0	5.1	1.5	2.2	9.6
Massachusetts	0.5	1.0	<1	0.7	1.3	1.3
Michigan	1.2	1.2	3.1	0.9	1.4	6.2
Minnesota	0.7	1.5	5.8	0.8	0.7	3.0
Mississippi	0.7	0.8	<1	1.5	1.8	3.6
Missouri	0.6	1.4	2.2	0.8	1.2	<1
Montana	1.0	1.9	<1	0.8	1.3	<1
Nebraska	0.8	1.1	<1	1.3	1.0	<1
Nevada	0.9	–	–	1.6	–	–
New Hampshire	0.9	–	–	0.8	–	–
New Jersey	0.6	1.1	0.0	0.5	1.1	<1
New Mexico	1.4	3.7	7.8	0.8	1.2	2.8
New York	0.6	1.3	7.9	1.5	5.1	8.9
North Carolina	0.7	0.9	3.1	0.8	–	–
North Dakota	0.7	1.0	<1	1.0	1.0	<1
Ohio	0.7	1.1	<1	0.6	2.1	3.5
Oklahoma	0.7	1.0	<1	0.7	0.9	1.4
Oregon	0.6	0.7	3.2	0.7	0.7	3.3
Pennsylvania	0.7	1.3	<1	0.9	–	–
Rhode Island	–	–	–	–	–	–
South Carolina	0.9	0.9	<1	0.8	1.3	2.8
South Dakota	1.3	1.1	1.7	0.8	0.9	1.8
Tennessee	0.9	1.3	5.5	0.7	1.0	5.6
Texas	0.5	0.7	1.0	0.6	1.3	2.6
Utah	0.9	1.4	6.7	0.9	0.7	5.1
Vermont	0.9	–	–	1.0	–	–
Virginia	0.9	0.7	3.4	0.6	–	–
Washington	0.7	1.3	4.4	1.0	0.9	6.1
West Virginia	0.7	0.8	1.7	0.8	0.8	0.6
Wisconsin	0.7	1.0	3.3	0.5	0.6	<1
Wyoming	1.2	–	–	0.5	1.0	<1
NATION	**0.2**	**0.3**	**1.3**	**0.2**	**0.5**	**0.9**

Notes: < 1 = Less than 1 percent of classes; – = Respondents too few for a reliable state estimate.

Source: NCES (1994c). Schools and Staffing Survey, Public School Teachers, 1990–91.

Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1995.

Appendix G
Directory of State Course Titles by Reporting Categories

State Science and Mathematics Indicators (Fall 1993)

CCSSO INDICATORS

Science Course Categories

State Course Titles (from State data forms)

Grades 7–8

General Science, 7–8

General Science 7, 8

Life Science, 7–8

Life Science 7, 8

Earth Science, 7–8

Earth Science 7, 8

Physical Science, 7–8

Physical Science 7, 8

Integrated Science, 7–8

Science I, II; SS&C; Project 2061; Integrated Science 7, 8; Earth/Life/Physical Science 7, 8

Other Science, 7–8

Grades 9–12

Biology, 1st Year

Biology I; General; College Prep.; Regents; Introductory; BSCS I

Biology, 1st Year, Applied

Basic Biology; Applied; Life Science; Biomedical Ed.; Animal Science; Horticulture Sci.; Bio. Science; Health Science; Nutrition; Man & Disease; Agricul. Science; Fundamentals of Biology

Biology, 2nd Year, Advanced Placement

Advanced Placement Biology

Biology, 2nd Year, Advanced

Biology II; Advanced; College; Psychobiology; Physiology; Anatomy; Microbiology; Genetics; Cell Biology; Embryology; Molecular Biology; Invertebrate/Vertebrate Biology; BSCS II

Biology, 2nd Year, Other

Zoology; Botany; Biomedical careers; Field Biology; Ecology; Marine Biology; Other Biological Sciences

Chemistry, 1st Year

Chemistry I; General; Introductory; Regents

Chemistry, 1st Year, Applied

Applied Chemistry; Consumer Chemistry; Technical Chemistry; Practical Chemistry; Chemistry in the Community

Chemistry, 2nd Year, Advanced Placement

Advanced Placement Chemistry

Chemistry, 2nd Year, Advanced

Chemistry II; Advanced; College; Organic; Inorganic; Physical; Biochemistry; Analytical

Physics, 1st Year

Physics I; General; Regents; Introductory

Physics, 1st Year, Applied

Applied Physics; Electronics; Radiation Physics; Practical Physics; Applied Conceptual Physics; Electricity

Physics, 2nd Year, Advanced Placement

Advanced Placement Physics

Physics, 2nd Year, Advanced

Physics II; Advanced; College; Nuclear Physics; Atomic Physics

Earth Science, 1st Year

Earth Science; Earth-Space Science; Regents Earth Science; Space Science

Earth Science, 1st Year, Applied

Applied Earth Science; Fundamentals of Earth Science; Soil Science

Earth Science, 2nd Year, Advanced/Other

Advanced Earth Science; Earth Science II; Oceanography; Aquatic Science; Marine Science; Astronomy; Geology; Meteorology

General Science

General Science; Basic; Introductory; Consumer Science

Physical Science

Physical Science; Interaction of Matter and Energy; Applied Physical Science

Integrated Science

Science III, IV; SS&C; Project 2061; Integrated Science 9, 10; Unified; Comprehensive Ideas of Investigations in Science; Life/Physical Science; Earth/Life/Physical Science; Coordinated Science

Environmental Science

Environmental Science; Environmental Education

Other Science

Technology; Science/Math; Engineering; Bioengineering; Special Interests Science; Energy; Research Topics; Laboratory Management; Science/Technology/Society; Aerospace Science; Aviation

Mathematics Course Categories

State Course Titles (from state data forms)

Grades 7–8

Remedial Math, Grade 7

Remedial Math 7

Math, Grade 7, Regular

Math 7; Exper. Math 7—SS MCIS

Math, Grade 7, Accelerated/Prealgebra

Accelerated Math 7; Prealgebra; Introductory Algebra; Honors Math 7; Enriched Math 7

Remedial Math, Grade 8

Remedial Math 8

Math, Grade 8, Regular

Math 8; Exper. Math 8—SS MCIS

Math, Grade 8, Enriched

Prealgebra; Accelerated Math 8; Honors Math 8; Enriched Math 8

Math, Grade 8, Algebra 1/Integrated Math 1

Algebra 1; Beginning Algebra; Elementary Algebra; Integrated Math 1

Grades 9–12

Review Mathematics

Level 1

General Math 1; Basic Math; Math 9; Remedial Math; Developmental; H.S. Arithmetic; Math Comp Test; Comprehensive Math; Terminal Math

Level 2

General Math 2; Vocational Math; Consumer; Technical; Business; Shop; Math 10; Career Math; Practical Math; Essential Math; Cultural Math

Level 3

General Math 3; Math 11; Intermediate Math

Level 4

General Math 4; Math 12

Informal Mathematics

Level 1

Prealgebra; Introductory Algebra; Basic; Applications; Algebra 1A (first year of two-year sequence for Algebra 1); Math A; Applied Math

Level 2

Basic Geometry; Informal; Practical; Core; Applied Math 2

Level 3

Basic Algebra 2; Mathematics of Consumer Economics; Applied Math 3, 4

Formal Mathematics

Level 1

Algebra 1; Elementary; Beginning; Unified Math I; Integrated Math 1; Algebra 1B (second year of two-year sequence for Algebra 1); Math B

Level 2

Geometry; Plane Geometry; Solid Geometry; Integrated Math 2; Unified Math II; Math C

Level 3

Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra; Algebra and Analytic Geometry; Integrated Math 3; Unified Math III

Level 4

Trigonometry; College Algebra; Algebra 3; Precalculus; Analytic/Advanced Geometry; Trigonometry and Analytic/Solid Geometry; Advanced Math Topics; Intro. to College Math; Number Theory; Math IV; College Prep Sr. Math; Elem. Functions; Finite Math; Math Analysis; Numerical Analysis; Discrete Math; Probability; Statistics

Level 5

Calculus and Analytic Geometry; Calculus; Abstract Algebra; Differential Equations; Multivariate Calculus; Linear Algebra; Theory of Equations; Vectors/Matrix Algebra

Level 5, Advanced Placement

Advanced Placement Calculus (AB, BC)

Computer Science Course Categories

State Course Titles (from state data forms)

Grades 7–8

Computer Science/Computer Programming

Introductory Programming (any language)

Grades 9–12

Computer Science/Programming I

Introductory Programming (any language); Programming I; Computer Language I

Advanced Computer Science/Programming II

Advanced Programming; Programming II; Computer Language II

Computer Science, Advanced Placement

Advanced Placement Computer Science

Source: Instructions and Reporting Forms for Data on Science and Mathematics Education in (each state). Council of Chief State School Officers, State Education Assessment Center, Washington, DC, Fall 1993.

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